ABSTRACT

Title of Thesis:	REDUCING THE RISK OF HONEY BEE COLONY LOSS THROUGH BEEKEEPING MANAGEMENT PRACTICES
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As primary pollinators in agricultural settings, managed honey bee colonies (*Apis mellifera* L.) are a highly value commodity for which demand is only growing. With high levels of colony loss experienced in the USA and around the world, there is demand for a better understanding of the drivers of colony mortality and identification of suites of management practices which are optimal for colony survivorship. This dissertation responds to these demands by summarizing the state of knowledge on the causes of colony loss (Chapter 1); describing the epidemiological tools used to investigate honey bee colony health (Chapter 2); describing the variability of colony loss across stakeholder typology, regions, seasons and years (Chapters 3 and 4); and investigating the association between management practices and colony mortality (Chapter 5).

Honey bee health, and ultimately, colony loss, is affected by multiple stressors acting concomitantly and sometimes interacting. Those stressors include pests and diseases, forage availability and pesticide exposure. Management practices have the potential, when used judiciously, to alleviate some of those stressors. Investigations of sets of management practices have been frustrated by the lack of methodology to handle large complex and incomplete datasets that are typical in observational studies. Using long term observational data obtained from the Bee Informed Partnership monitoring of honey bee colony losses and management practices in the US, we were able to describe the variation in colony loss across years, seasons, States and stakeholder's types. In parallel, we summarized management information into a quality index, based on experts' opinion, and confirmed the association between management practices quality and overwintering colony loss. Further, we ranked individual practices based on their associated potential reduction in colony mortality. Because our method accounts for the pre-existing prevalence of practices, we propose that those sets of practices should be prioritized as recommendations, rather than those identified by experts, to derive the highest reduction in risk of colony mortality. The methodology we developed could benefit other Ag or epidemiological systems interested in the summarization of a great number of practices and their prioritization based on highest potential to reduce risk.

REDUCING THE RISK OF HONEY BEE COLONY LOSS THROUGH BEEKEEPING MANAGEMENT PRACTICES

by

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Preface

The present dissertation is composed in part as a compilation of publications prepared in the course of my PhD project. Chapter 1 was prepared for an invited review for Current Opinion in Insect Science special issue on Bee Disease. Chapter 2 was published in a book of scientific popularization targeted towards beekeepers and the general public. Chapter 3 was published in the Journal of Apiculture Research as the seventh iteration in a series reporting on the Bee Informed Partnership Loss Survey.

Dedication

Je dédicace cette thèse à mes parents

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Table of Contents

List of Tables

List of Figures

General Introduction

In the fall of 2006, beekeepers from across the USA started reporting cases of colony collapses that stood out from the typical pattern of colony mortality because of, among other characteristic symptoms, the rapidity of the collapse and the absence of dead bees in the hive or apiary (vanEngelsdorp et al., 2009). The condition, described and branded as “Colony Collapse Disorder” (CCD) prompted researchers to ask a series of questions yet unanswered: what should be considered a “normal” level of colony mortality? How is the variability in the risk of colony mortality shared across the stakeholder community? What are the major causes of colony loss, and what is their relative importance? Is population size – a traditional metric of population health in most ecological studies – appropriate for a managed and eusocial system such as the honey bee? In the wake of CCD, the first Loss Survey was organized to document the level of colony loss experienced by US beekeepers (vanEngelsdorp et al., 2007). In ten years of documentation of the operational loss experienced by US beekeepers, the Loss Survey allows us to answer some of those questions. We explore the variability of colony loss over time, throughout the seasons, space and across the industry in Chapter 3 (2012-13 survey) and Chapter 4 (ten year summary).

Managed Honey bees (*A. mellifera* L.) represent a unique opportunity to investigate complex health issues affecting a social species. Honey bee health, and ultimately, colony loss, is affected by multiple stressors acting concomitantly and sometimes interacting (Maggi et al., 2016; Pirk et al., 2016; vanEngelsdorp and Meixner, 2010), which we explore in Chapter 1: Drivers of honey bee colony losses. The epidemiological methods used to document and investigate health outcomes and the associations between health and stressors are described in Chapter 2: Using Epidemiological methods to improve honey bee colony health.

Honey bee health stressors include pests and diseases, forage availability and pesticide exposure. Management practices have the potential, when used judiciously, to alleviate some of those stressors. In periods of dearth, for example, management can provide supplemental feeding (Brodschneider and Crailsheim, 2010). When facing high pest pressure, proper management can reduce impact through physical or chemical intervention (Giacobino et al., 2015a). But other aspects of management can also increase the exposure to risk factors, such as pests. For example, as primary pollinators of agricultural crops, honey bees can be congregated in high densities around crops (USDA ERS, 2014), which is generally associated with higher disease infection rates (Forfert et al., 2016). While good management can alleviate stress, bad management can accentuate them (Giacobino et al., 2016a; Jacques et al., 2017). In Chapter 5, we take advantage of the long term observational survey to document the prevalence of important management practices, and relate their use to the risk of colony mortality. In particular, we propose a system to summarize management practices into an index of quality based on expert opinions and assess the association between management practices and colony mortality risk.

As the primary pollinator in agricultural settings (Klein et al., 2007), managed honey bee colonies are a highly value commodity for which demand is only growing (Aizen and Harder, 2009). With high levels of honey bee colony loss experienced in the USA (Kulhanek et al., 2017; K. V. Lee et al., 2015; Seitz et al., 2015; Spleen et al., 2013; Steinhauer et al., 2014; vanEngelsdorp et al., 2007, 2008, 2010, 2011b, 2012) and around the world (Antúnez et al., 2017; Pirk et al., 2014; van der Zee et al., 2012, 2014) there is demand for a better understanding of the drivers of colony mortality and identification of suites of management practices which are optimal for colony survivorship (The Pollinator Health Task Force et al., 2015).

This thesis responds to this demand by targeting each of the following specific goals:

1) Summarizing the state of knowledge on the causes of colony loss and their relative risk (Chapter 1);

2) Describing the epidemiological tools used to investigate the issue of honey bee colony health (Chapter 2);

3) Describing the variability of colony loss across seasons, space, stakeholder typology and over time (Chapters 3 and 4);

4) Investigating the association between management practices and the risk of colony mortality (Chapter 5).

Chapter 1: Drivers of honey bee (*Apis mellifera* L.) colony losses

Abstract

Managed honey bees (*Apis mellifera* L.) are facing a wide range of stressors, from pests and pathogens, to pesticides and nutritional stress. To estimate the risk associated with a particular stressor, both the severity of its impact on bees and its probability of encountering the bees, need to be estimated. Research on drivers of honey bee health need to be increasingly dedicated to address both of those issues simultaneously. Given the variability in stressor's prevalence, the complex web of inter-relations between potential risk co-factors, and the dynamic nature of the system, such risk assessments would best be performed at a local scale and consider changes of potential impact and prevalence over time. The long-term success of beekeeping and honey bees relies upon continued exploration and monitoring of the ever-changing factors impacting bee health.

Introduction

Managed honey bees (*Apis mellifera* L.) represent a unique opportunity to investigate complex health issues affecting a social species. As primary managed pollinators of agricultural crops (Klein et al., 2007), they have been intensely researched in a variety of environments and conditions, all throughout their extended range.

To perform a risk assessment on any potential driver of colony health, two important aspects need to be estimated - the severity of the impact (hazard) caused by the driver and the likelihood of encountering the driver (prevalence, or exposure).

Quantifying the prevalence of a risk factor, as well as its spatial and temporal variations, might seem straightforward, but requires significant resources. For instance, the exposure of honey bees to pesticides is likely to vary across regions (Lawrence et al., 2016) as well as throughout the season (Tsvetkov et al., 2017). Tracking these variations across time and space requires significant labor, and field experiments of this nature are often difficult to control. Though recent efforts have tried to quantify the total exposure of honey bee colonies to pesticides (Traynor et al., 2016a), the methods used are variable and can result in discrepancies between studies (Benuszak et al., 2017).

Measuring a driver's impact is at least equally challenging, because many different response variables, on many different scales, need to be quantified. For instance, a dose of insecticide lethal to an individual bee might not readily translate into a measurable damage for a whole colony (Woodcock et al., 2017). In addition, the impact of a driver itself might be variable over time and space. For example, some bee viruses associated with *Varroa destructor* have increased in virulence over time (McMahon et al., 2016).

Relatively high rates of colony losses have been and continue to be reported worldwide (USA (Kulhanek et al., 2017), South America (Antúnez et al., 2017), Europe (van der Zee et al., 2014), South Africa (Pirk et al., 2014), in contrast with low levels of loss observed in some parts of Asia, including China (Liu et al., 2016)).

Honey bee health, and ultimately colony loss, is affected by multiple stressors (Maggi et al., 2016; Pirk et al., 2016; vanEngelsdorp and Meixner, 2010). Assessing the risk associated with individual stressors, let alone teasing out the respective contribution of each stressor to colony loss, is almost pragmatically impossible. Many stressors are related and often interact with one another in the field, making it difficult to determine the relative risk each one poses. For instance, increased chemical use and reduced diversity of floral resources are two stressors known to impact honey bee health on their own (Henry et al., 2012; Smart et al., 2016), but they can also act together, potentially in synergy (Démares et al., 2016). Since both are consequences of land-use change, their distribution is likely correlated, making it hard to identify the effect of one without the other in field settings. Other examples of interaction abound: nutritionally-stressed worker bees are less tolerant to pathogen infection (Di Pasquale et al., 2013); Boscalid, a commonly used fungicide, which does not cause mortality to honey bee workers on its own, doubled the oral acute toxicity of neonicotinoids (Tsvetkov et al., 2017). Clearly, assessing a single stressor on its own is not representative of actual conditions colonies experience. Conversely, assessing all potential stressor combinations is unattainable, given the number and variety of these risk factors.

In this review, we attempt to summarize a number of identified drivers of colony health as grouped by logical flow from ultimate cause to most proximal effect. We will not consider the number of managed honey bee colonies over time as it is highly influenced by socio-economic factors, such as the price of honey and/or pollination demand. These factors are known to influence the number of beekeepers and their ability and/or desire to restore or increase their colony numbers (Moritz and Erler, 2016; Potts et al., 2010b; vanEngelsdorp and Meixner, 2010). This review is not meant to be an exhaustive list of potential drivers and their mechanisms, rather it is meant to highlight recent research that either quantifies the prevalence and/or the impact of identified stressors. We devote special attention to research focusing on colony-level outcomes to address the question of drivers of honey bee health.

Land-use changes and consequences

Land-use change includes loss, fragmentation and homogenization of habitat, and/or a decrease in quality of habitat and associated resources. Land-use change is also typically associated with an increase in chemical and mechanical inputs, which can be tied to landscape quality. Finally, an increase interconnectivity of ecosystems with resulting change in species distribution is sometimes also linked to land-use change, and we will address the impacts of pests, pathogens and predators later in this review.

Loss and fragmentation of habitat

When assessing the risk of habitat loss and fragmentation on bees *sensu largo*, habitat loss is considered the most important driver of species decline, both in abundance and diversity (see reviews in (Brown and Paxton, 2009; Goulson et al., 2015a)). Deforestation is a major cause to habitat loss and ecological imbalance. Deforestation has been rising at an alarming rate especially in South East Asia, a geographic center of honey bee distribution and diversity.

As a semi-domesticated species with nesting habitat provided by beekeepers, managed honey bees are partly protected from changes in habitat and resource quality. While managed honey bees are constrained to an apiary location chosen for them, they range freely in the surrounding environment. The habitat surrounding the apiary can have marked effects on nutrition and colony health, as stated in the following section.

Habitat loss also results in the fragmentation of suitable habitats, which can isolate sub-populations, resulting in decreased genetic diversity (Zayed, 2009). There is growing interest for estimating wild or feral honey bee populations (Jaffe et al., 2010; Lozier and Zayed, 2017), particularly as a source of diversity to improve managed honey bee stocks. For managed honey bee populations, management practices are likely a stronger determinant of gene flow than habitat fragmentation (Lozier and Zayed, 2017).

Decrease in resource availability and nutrition

The landscape around an apiary represents a colony's naturally available nutrition. While supplemental feeding by the beekeeper is possible, it is not as nutritious as natural forage (Brodschneider and Crailsheim, 2010). The effect of nutrition on honey bee health is well accepted and supported by research (reviewed in (Brodschneider and Crailsheim, 2010)). Despite this, the quality and amount of habitat needed for supporting large numbers of commercially managed honey bee colonies in the US Northern Great Plains has decreased over the last 10 years (Otto et al., 2016).

Often as a result of poor nutrition or landscape quality, beekeepers frequently report "starvation" as one of the leading causes of colony loss over the winter (Kulhanek et al., 2017). Outright starvation of the colony is usually avoidable, however, through adequate feeding and good management of the honey stores. Still, sub optimal feeding of individual bees within a colony, particularly larvae, can lead to other sub-lethal effects. For instance, honey bees' fed highly diverse pollen diets when they were larvae are more tolerant of parasites (Di Pasquale et al., 2013). Malnutrition could also display chronic effects, such as nutritionally stressed larvae developing into poor foragers as adults, which could exacerbate the pollen deficiency of the colony (Scofield and Mattila, 2015).

Landscape affects managed honey bee health both directly (*e.g.* colony performance and outcomes, (Smart et al., 2016)) and indirectly (*e.g. V. destructor* infestation levels, (Giacobino et al., 2017)). The mechanisms behind these indirect associations are multiple. For instance, environmental conditions affect colony development, which in itself affects *V. destructor* population growth (Meixner et al., 2015). Thus landscape quality and forage resource availability can exacerbate existing health issues, impacting multiple aspects of colony vitality.

Pesticide use

Pesticides englobes a variety of products: including herbicides, insecticides and fungicides, each with various families of products with specific mode of actions. While we will focus this discussion on products with direct measurable toxicological impacts on bees, it should be noted that some xenobiotic products can have indirect effects on colony health. For instance, herbicides, often regarded as bee safe, can reduce the diversity and availability of food sources, which links back to the issue of resource quantity and diversity (Bretagnolle and Gaba, 2015).

The distinction between exposure and impact in the toxicological risk assessment of pesticides is most critical, because the gravity of the impact is directly dependent on the dose and route of exposure. The most frequent criticism of pesticide impact studies on bees is that the dose, timing and exposure routes used in those studies are not representative of field conditions (Collison et al., 2016). Numerous studies have attempted to quantify pesticide exposure under field conditions (Chauzat et al., 2011; Traynor et al., 2016a; Tsvetkov et al., 2017). However, a variety of methods can been used to qualify those exposures, with sometimes contradicting results (see review of the sampling methods, matrices and gaps in knowledge in (Benuszak et al., 2017)). The consensus of those studies is that in most cases, honey bees are exposed to low levels of a combination of pesticides simultaneously, and for extended periods of time (Sanchez-Bayo and Goka, 2014). This is often not properly replicated in lab-based exposure and toxicity experiments, and researchers are now trying to better replicate field conditions.

To better reflect field conditions, impact studies have shifted towards studying the effects of low level, chronic exposure, and/or the use of multiple products at one time (Dively et al., 2015; Tsvetkov et al., 2017). Some of these studies examine the sub-lethal effects of field realistic doses, on individual honey bees. For example, proboscis extension reflex (PER) tests have shown that sublethal doses of pesticides can reduce olfactory memory, learning performance and sucrose sensitivity of bees (Démares et al., 2016; Desneux et al., 2007). Some of those sub-lethal effects have been confirmed in field experiments. For instance, Radio Frequency Identification (RFID) monitoring revealed how bees exposed to neonicotinoids displayed abnormal foraging activity and disrupted homing behavior compared to unexposed bees (Henry et al., 2012). Recent research has helped close some knowledge gaps, such as the effect of age, where young bees were found more vulnerable to impaired learning (Mengoni Goñalons and Farina, 2015). Physiological effects of neonicotinoids such as body thermoregulation, which is essential to brood rearing, have also been studied ((Tosi et al., 2016). Sub-lethal effects from non-neonicotinoid products (the herbicide glyphosate) have been found affect honey bees homing abilities, though in concentrations from the upper margin of realistic field levels (Balbuena et al., 2015). Current research is delving increasingly into the effects of real possible in-field levels of pesticide exposure.

Honey bees are eusocial, meaning each colony acts as its own organism and reproductive unit. However, effects on individual bees could translate to reduced colony performance, and potentially colony mortality. Modelling tools have been used to estimate how individual effects integrate into overall colony outcome (Henry et al., 2012). But the integration of individual effects too often neglects mechanisms acting at the colony level. For example, enzymatic detoxification is limited in individual honey bees, but might be complemented by social behaviors at the colony level, such as the dilution of pesticides loads by pollen mixing (Berenbaum and Johnson, 2015). In field experimentation, colony-level impacts are hard to quantify, especially under field-realistic low level exposures (Dively et al., 2015). In addition, the testing of multiple combinations of products, and their long term impacts, would require a high level of replication. These studies are expensive and often are pragmatically not possible. Observational studies may help provide insights when experimentation may not be appropriate or feasible. For instance, (Traynor et al., 2016a) quantified the total exposure of migratory colonies to pesticides throughout a season and its association to several colony health outcomes. Though inadequate to identify causal relations, observational studies such as this can add arguments to the qualification of potential impacts in realistic field conditions.

Changes in species distributions

The movement of species has been accentuated by the increased connectivity between landscapes due to human activities. European honey bees were deliberately introduced throughout the world. In fact outside of their natural range honey bees can compete with native bees (Schweiger et al., 2010). The hybridization between local and introduced sub-species of honey bees (for example, *A.m. ligustica* and *A.m. carnica* dissemination throughout Europe) can also be detrimental for genetic diversity and local adaptation (Byatt et al., 2016; De la Rúa et al., 2009; Meixner et al., 2010, 2015).

With the movement of honey bees, their associated pests and pathogens can spread. The movement of European bees to Asia allowed for the eventual near global distribution of the honey bee parasite *V. destructor* (Rosenkranz et al., 2010). The rapid spread of small hive beetle has largely been attributed to the movement of bees and beekeeping equipment (Neumann et al., 2016). Potentially invasive species are actively monitored by surveillance programs (K. Lee et al., 2015) specific to each geographical region to allow for early reaction to emerging threats (e.g. small hive beetle first detection in Italy, (Laurent et al., 2015), and Tropilaelaps surveillance in the US, (Traynor et al., 2016b)).

Pests and pathogens

Honey bees are susceptible to many pests, parasites, parasitoids and pathogens. These threats vary in severity and prevalence. Some have been associated with honey bees for a long time, with their relative importance changing over time. For instance, American foulbrood (*Paenibacillus larvae*) was the most economically important threat to honey bees prior to 1970s in North America and Europe (Sherman et al., 1988). Active inspections programs that require the destruction of infected colonies keep the incidence of the disease low, however, outbreaks still occur (vanEngelsdorp et al., 2014). Another threat more recently associated with honey bees is *Varroa* (*V. destructor*). This mite switched host from the Asian honey bee to the European honey bee and extended its range ever since (Chantawannakul et al. 2017). This mite was most recently introduced into New Zealand in 2000 and has Australia bracing for impact (Iwasaki et al., 2015).

A full list of all pests and pathogens associated with honey bees is out of purview of this review, and their prevalence and potential impact is variable across regions. Above all, wherever present, *Varroa* is usually presented as the most economically damaging threat to beekeeping (Genersch, 2010; Maggi et al., 2016; Rosenkranz et al., 2010). *V. destructor* is detrimental both because of its widespread prevalence and highly damaging effects, mostly from its associated viruses. Another parasitic mite, Tropilaelaps (*Tropilaelaps mercedesae*) possesses even more potential for impact (Guzman et al., 2017), and considerable efforts are implemented to delay and limit its spread outside of tropical and temperate zone in Asia (USDA APHIS, 2017).

A recent insight in the assessment of honey bee antagonists is how their impact has changed over time, independently of their prevalence. For instance, the arrival of *V. destructor* provided a new route of transmission for viruses, thereby modifying the viral community structure associated with bees (Martin et al., 2012). The relative abundance of viral species changed, and the prevalence of a select few, such as Deformed Wing Virus (DWV) increased. Among viruses that increased, particular strains were favored resulting in massive reduction in the genetic diversity of the remaining predominant strains. Recently, a field survey in UK confirmed that the most widespread genotype is also the most virulent (McMahon et al., 2016). This would explain the ever decreasing damage threshold of *Varroa* loads. By spreading increasingly virulent viruses, lower numbers of mites result in higher injury (vanEngelsdorp and Meixner, 2010).

If evolution in the pathogens' virulence has modified impact over time, so has the host's response to infection. *Varroa* was thought to have wiped-out feral honey bee colonies in the US, but some recently identified honey bee populations withstand mite infestations without intervention (Seeley et al., 2015). Recent research has focused on identifying the pathways of tolerance or resistance to *Varroa* (Seeley et al., 2015;

Strauss et al., 2016) in the hopes of identifying traits which could be selectively bred into susceptible honey bee populations.

Thanks in large part to the revolution in genomic studies that can identify new viruses and organisms to a degree we have never been able to before, new antagonists are continuously added to the list of biological threats to honey bees (Remnant et al., 2017). This variability in prevalence highlights the importance of local or regional epidemiological surveys, which help illuminate the spatial and temporal variation of stressors and provide region-specific risk assessments (Antúnez et al., 2015; Meana et al., 2017; Pirk et al., 2014; Traynor et al., 2016b).

Beekeeping management practices

Beekeeping practices impact honey bee colony health in many ways. Good management practices can reduce stress, such as nutritional stress or pest pressure. In periods of dearth, management can provide supplemental feeding (Brodschneider and Crailsheim, 2010). When facing high pest pressure, proper management can reduce their impact through physical or chemical intervention (Giacobino et al., 2015a). While good management can alleviate stress, bad management can accentuate them (Giacobino et al., 2016a; Jacques et al., 2017).

Some aspects of management can also increase the exposure to risk factors, such as pests. As primary pollinators of agricultural crops, honey bees can be congregated in high densities around crops. In the US, almond pollination in California requires between 60 to 75% of the country’s commercial hives (USDA ERS, 2014). High density of colonies is generally associated with increased disease infection rates

(Forfert et al., 2016). Attempts to minimize these risks often require that colonies that move across states be inspected (Pettis et al., 2014). In practice, however, migratory colonies in the US display lower *Varroa* loads than stationary beekeepers (Traynor et al., 2016b).

Management practice can also impact honey bee health directly. For example, migratory management has been associated to heightened oxidative stress and shorter lifespan for individual bees (Simone-Finstrom et al., 2016). Another example, the regular admixing of the managed population compromises the isolation of locally-adapted ecotypes, which have been shown to perform and survive better than non-locally adapted ones. However, though management is usually believed to be associated with a reduction of genetic diversity, managed honey bee populations have been found remarkably diverse (Lozier and Zayed, 2017). (Meixner et al., 2015). Despite this diversity, managed populations exhibit a reduction in immunity levels compared to feral colonies. (López-Uribe et al., 2017). The intrinsic differences between managed and feral honey bee populations are just beginning to be studied, and there is much to learn about how the two groups can support each other.

Indirect and Interactive effects

As stated at the beginning of this review, honey bee health is affected by a multitude of stressors, both acting concomitantly and potentially interacting.

Indirect effects denote situations in which a factor impacts the prevalence of a direct stressor. For instance, environmental variables were more strongly associated with *Varroa* loads than management practices, at least on large geographical scales

(Giacobino et al., 2017). Thus environmental variables have an indirect effect on colony health by affecting the direct stressor of *Varroa*. Herbicides, which have no toxicological impact on honey bees, have indirect effects as they can reduce the diversity and availability of food sources (Bretagnolle and Gaba, 2015). Many honey bee health stressors are indirectly affected by fluctuating factors around the colonies, complicating risk analyses of each stressor.

Interactions denote situations where two or more variables affect an outcome in a non-additive manner (either synergistic or antagonistic), so the impact of a stressor is increased or decreased when combined with another variable. These interactive effects have been most successfully demonstrated with combinations of different pesticides. For instance, neonicotinoids' LD50 varies in the presence of fungicides (Tsvetkov et al., 2017), confirming the presence of interactive effects of the two pesticide classes. While the theory of interactive effects has been present for some time (Potts et al., 2010a), recent efforts have focused on demonstrating these in laboratory studies (Goulson et al., 2015a) and understanding the underlying mechanisms of those synergies. The mechanisms that drives these synergies are not always simply a function of overloading the bees detoxification pathways (Berenbaum and Johnson, 2015). For instance, neonicotinoids reduce honey bees' immune defenses by inhibiting immune signaling, which in turn, promotes the replication of Deformed Wing Virus (DWV) (Prisco et al., 2013). When co-exposed to both viral infection and contamination by a surfactant adjuvant, previously considered biologically inert, developing bees showed reduced expression of a receptor involved in viral defense (Fine et al., 2017). These interactive effects remain hard to confirm, under field-realistic levels of exposure, affecting colony-level outcomes (Collison et al., 2016).

Conclusion

Honey bee colonies can fail for a variety of reasons (Maggi et al., 2016; Pirk et al., 2016; vanEngelsdorp and Meixner, 2010). The risk association with each driver of loss is quantified by both its prevalence and its impact. This makes the risk of a specific driver dependent of the region and population considered.

In most cases, pests and pathogens remain the proximal and most tangible cause of colony loss (Genersch, 2010). However, identifying the proximal cause of death offers only partial answers to the drivers responsible for poor colony health. Stressors can act indirectly, in association, or synergistically (Goulson et al., 2015a), and those high level effects are more difficult to identify and quantify in the field.

Finally, there is no guarantee that factors improving short term survival rates provide long term sustainability of beekeeping services. Other measures of health should complement mortality rates to provide broader perspective on the issue, for example, genetic diversity in terms of locally adapted ecotypes (Lozier and Zayed, 2017).

While progress has been made to better understand risk factor and their interactions, the long-term success of beekeeping and honey bees relies upon continued exploration and monitoring of the ever-changing factors impacting bee health.

Chapter 2: Using epidemiological methods to improve honey bee colony health

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<u>Abstract</u>

Honey bees have been dying in the US and in other countries at high rates for over a decade (Laurent et al., 2015; Seitz et al., 2015). Beekeepers have questions: *How many managed honey bee colonies died last winter in the US? How did my operation compare? How many Nosema spores per bee are needed to justify treatment? What number of Varroa mites can live in my colony without hurting it? How should I treat an outbreak of European foulbrood? What can I do to reduce the chances of getting American foulbrood?* These are the kind of questions epidemiologists try to answer. Using real world examples, we hope to give you a quick overview of what epidemiology is and how it works. First off, epidemiology is all about measuring 1)

how much disease there is and 2) what factors contribute to the occurrence or absence of disease. So if you are a beekeeper, and you want to keep your bees alive (and why wouldn't you?), you should first understand the ways disease and risk are calculated and used to develop strategies to maximize bee health. This chapter is meant to do just that – give a quick epi primer – so you and your fellow beekeepers have some way of self-evaluating new and old research about bee health and management and figure out how to apply new knowledge when managing your colonies.

What is epidemiology?

Epidemiology is the study of disease levels in a population. Epidemiologists use a broad definition of "disease": any departure from perfect health. Honey bees pose a particular problem for epidemiologists as it is hard to define what a colony in perfect health would look like. Fortunately diseased colonies are easier to identify.

When measuring disease, or a departure from perfect health – we use both direct and indirect measures. **Direct** measures are easiest to understand. You go to a hive and see symptoms that look like American foulbrood (AFB), you take samples and send them to a lab, and the samples come back positive: your colony has AFB. But as all beekeepers know, honey bee colonies are complicated, and since we can't ask the bees how they are feeling we have to use several **indirect** measurements to assess how healthy a colony is. Good beekeepers do this every time the inspect colonies – what does the brood pattern looks like? How many frames of bees and brood and food are present? How is the queen doing? Is the colony alive? Obviously, a dead colony is the worst and most extreme "disease" outcome there is.

To be honest, epidemiologists are not really interested in how disease might affect a single individual (another epidemiological challenge **–** What is an individual in the beekeeping context? A bee? A colony? An apiary? **–** but more on that later), rather, epidemiologists focus on how disease spread and persist (or not!) in a population. The ultimate goal of epidemiologist is disease prevention, and so epidemiologists also evaluate prevention strategies and devise and evaluate ways to get the proven best practices widely adopted.

At the core, there are two different types of epidemiological studies, descriptive studies and analytic studies. As their name suggests, **descriptive studies** are designed to describe a disease, how widespread it is, where it occurs, when it occurs, etc. These studies do not necessarily try to link disease outcomes with cause(s). **Analytical studies,** on the other hand, are designed to determine which factors are related to disease outcomes. By measuring "exposure variables" (also called, "risk factors") and the occurrence (or not!) of a disease, analytical studies quantify the chances an individual will develop a particular disease after a certain exposure.

So if we think again about AFB, a descriptive study would endeavor to find out how many diseased colonies there are in a certain area over a certain period of time, while an analytical study would attempt to find factors that increased the chances that a colony would have AFB. Sometimes these risk factors are self-evident, *e.g.* buying used equipment from a neighbor who had a major AFB problem and did not know it. The key point of analytical studies is to measure the **risk** or **chance** of developing disease after an exposure. It is important to remember that in many cases not all colonies exposed to a risk factor will get the disease, and not all colonies suffering from a disease will have been exposed to the same risk factor(s). Using our AFB example again, after being exposed to AFB spore-contaminated brood comb (Lindström et al., 2008a), 2 of 5 colonies developed AFB infections, meaning, 3 colony on 5 did not showed clinical symptoms of AFB even when sharing the same exposure. Conversely, not all cases of AFB are the result of introducing contaminated comb into uninfected colonies, bees can rob honey from infected colonies and bring the pathogen home starting an infection (Lindström et al., 2008b).

Surveillance and monitoring in honey bee health

Surveying a population for disease is the most basic form of a descriptive study. Systematic surveys conducted over time can help define “normal” disease rates in a population. Importantly, once we know what normal disease levels are, survey results help identify outbreaks and/or hotspots of disease occurrence. As one can imagine, finding a new disease early, before it spreads widely, is the reason many surveillance efforts are implemented. Knowledge of where and when a disease emerges is the starting point for many epidemiological investigations.

Beekeepers do this informally all the time. Every time you open and inspects a colony and look for evidence of brood disease you are “surveying” your operation. Of course other surveillance efforts, such as conducted by state apiary inspectors, are more structured and systematically look for disease within the operations of their purview on a regular and long term basis. For survey data to have the most value, clear protocols are required so that data from many different inspections are comparable.

Such data, aggregated over time and space, has huge value, as it can compare bee health over time and also provide insight on the relationship between colony health measures.

Illustration 1. **Apiary Inspections: an example of Surveillance Program**. In the early 1900's, in response to the high prevalence of the highly contagious "foul brood" (this was before the bacteria responsible was identified and the condition re-named "American Foulbrood") in the United States, many US states enacted bee laws that mandated the inspection of honey bee colonies on a regular basis to help find and then destroy colonies that were contaminated (Burgess and Howard, 1906). The Pennsylvania Department of Ag kept records of AFB prevalence that date back to the 1940s. When the survey was first conducted, the AFB was found in 12% of all the apiaries inspected. In the 2000s, it was well below 1% (unpublished). Note that this data says nothing about why the disease rate went down.

Systematic monitoring allows for early detection – and reaction – to the appearance of newly emerging diseases. Let's be honest, bees have faced and continue to face a lot of threats. Over one hundred years ago, one of the biggest problems faced by American beekeepers was Wax moth. Since then, we have had to face AFB, chalkbrood, sac brood, honey bee tracheal mite, *Varroa*, small hive beetle, more than a dozen viruses and we are now threatened by Asian hornets (racking havoc in France and other places in Europe), even more viruses, and the Tropilaelaps mite. The accidental introduction of Tropilaelaps mite into any country is the one threat that should keep beekeepers awake at night. Like *Varroa*, it evolved on a different species of honey bee and jumped host. In some places in Asia where they keep European honey bees they have to treat for the mite once every two weeks (Pettis et al., 2013)! The value of a surveillance system (reviewed in Lee et al., 2015) is to ensure that if Tropilaelaps mites are introduced into the US, detecting it early would allow for interventions which would hopefully eradicate the problem before it became wide spread.

Box 1: Measures of disease frequency

Epidemiologists have their own jargon, which you will likely encounter in study summaries or reports. Here are some of the most common and useful terms defined. *Prevalence* and *incidence* are two measures of disease in a population, and so usually the main result of descriptive studies (see Figure 2.1). **Prevalence** is the proportion (usually expressed as percentage) of existing cases in a known population. It indicates how frequently a disease is present in a population during the survey time frame. If the survey randomly selected colonies to inspect, one way to interpret prevalence is the probability that any subject in a population has the disease. **Incidence** is the number of new cases that developed over a specified period of time in the population at risk. It specifically relates to the transition from a healthy state to a diseased state rather than just the number of diseased individuals. In the apiary depicted in Figure 2.1, the prevalence of the "disease" was 37.5% (3 of 8) on Date 1. The second inspection found that 4 of the 7 were infected, so the prevalence was 57.1%. During the interval between Date 1 and Date 2, the incidence of the disease was 60% (3 new infections in the 5 that were “at risk” – those that were not infected during the first inspection). Mortality rates are also a form of incidence. In the case we have just discussed, all 8 colonies originally inspected were at risk of dying, one did die so the incidence (or mortality) rate was 12.5% (1 of 8) for the period of time between Date 1 and Date 2.

Figure 2. 1: Incidence and Prevalence.

Fictitious apiary represented at 2 different dates. Legend: Green colonies = disease absent; Red colonies = disease present; Black colonies = colony died. One Date 1, three of the eight colonies are diseased. The prevalence of the disease is 3/8 = 37.5% on Date 1. On Date 2, one of the diseased colony has recovered, one is lost and three previously healthy colonies became diseased. The prevalence of the disease on Date 2 is 4/7 = 57.1%. The incidence of the disease between Date 1 and Date 2 is of 3/5 = 60% (three new cased among the five healthy, at risk, colonies on Date 1).

Disease loads

Disease frequency (See Box 1) is useful in understanding bee health in some context but not others. When a disease is ubiquitous, then not much useful information is gained by just knowing if colonies have or do not have the disease. In other words, sometimes it is not the prevalence that matters, it is the disease’s **load** that matters.

For most diseases, and in particular infectious disease, the gravity of infection in diseased individuals provides a more complete picture than the simple presence or absence of the disease.

For example, nearly every colony in the continental United States has *Varroa*, specifically between 2011 and 2015 *Varroa* were detected in 91.7% of colonies sampled (*i.e.* 91.7% prevalence, (Traynor et al., 2016b)). Please note we specifically and deliberately used the word *detected* – as, in all likelihood, the prevalence was much greater and the negative detections probably were the result of recent *Varroa* treatment applied by the beekeeper before inspection, so that, while mites were present they were at very low – undetectable – levels. We discuss the idea of test sensitivity and specificity in Box 2. If about every colony is infected with *Varroa* then there is little value in knowing the prevalence (mere presence/absence) in order to help understand bee health. The real data of import is how many *Varroa* are found in a colony – the colonies mite **load** (Figure 2.2). This information is predictive and actionable.

Values related to disease loads may be used as the trigger for management decisions (such as deciding which colonies to use as breeder stock, or when to applying a chemical or non-chemical control strategy). The *Varroa* load that currently warrants action – the **action threshold** – is a little tricky to pin down. It depends – on the time of the year (high levels early in the season are more concerning then a comparable level latter in the season), on the viruses the mites are vectoring (*Varroa* can spread very fast acting virus which can wipe out much of an operation even when mite levels remain low), and on the region (with or without an interruption of brood due to winter). Disease loads often have a seasonality (Figure 2.2). Knowledge of this seasonality is helpful when designing management tools to reduce losses. Mite levels peak in the US population in late summer/early fall. This is also the time that colonies begin to crash from heavy mite infestations. When a colony crashes from *Varroa*, many of those mites are spread to neighboring colonies by the drift of the collapsing colonies last bees or by robbing bees that pick up *Varroa* while plundering the honey reserves of the collapsing colony (Frey and Rosenkranz, 2014). For this reason beekeepers are urged to check mite levels in hives at least once a month, particularly in the fall, when mite pressure increases from natural population growth, shrinking of the brood nest, and invasion from neighboring colonies. This is also the time when bees kept in northern locations switch from the production of short lived summer bees to long lived winter bees, and so heavy parasitism of the developing winter bees will increases the risk colonies will die even if mites are controlled after these bees emerge.

So if for some conditions, such as *Varroa*, disease load is more informative than prevalence, it is the opposite for diseases that are highly contagious swift acting. AFB is highly contagious and persistent, and so some state laws requires total destruction of diseased colonies even if the colony has just one AFB scale present. This makes sense when one considers that one AFB scale can contain several billion spores, that these spores remain infectious for at least 50 years, and it only takes less than 10 spores to kill a larval bee if it was feed the spores in the first day of its larval life (LD_{50}=8.49, Brødsgaard et al., 1998). So in the case of AFB, a disease load of 1 scale is a sufficient threshold to implement control strategies.

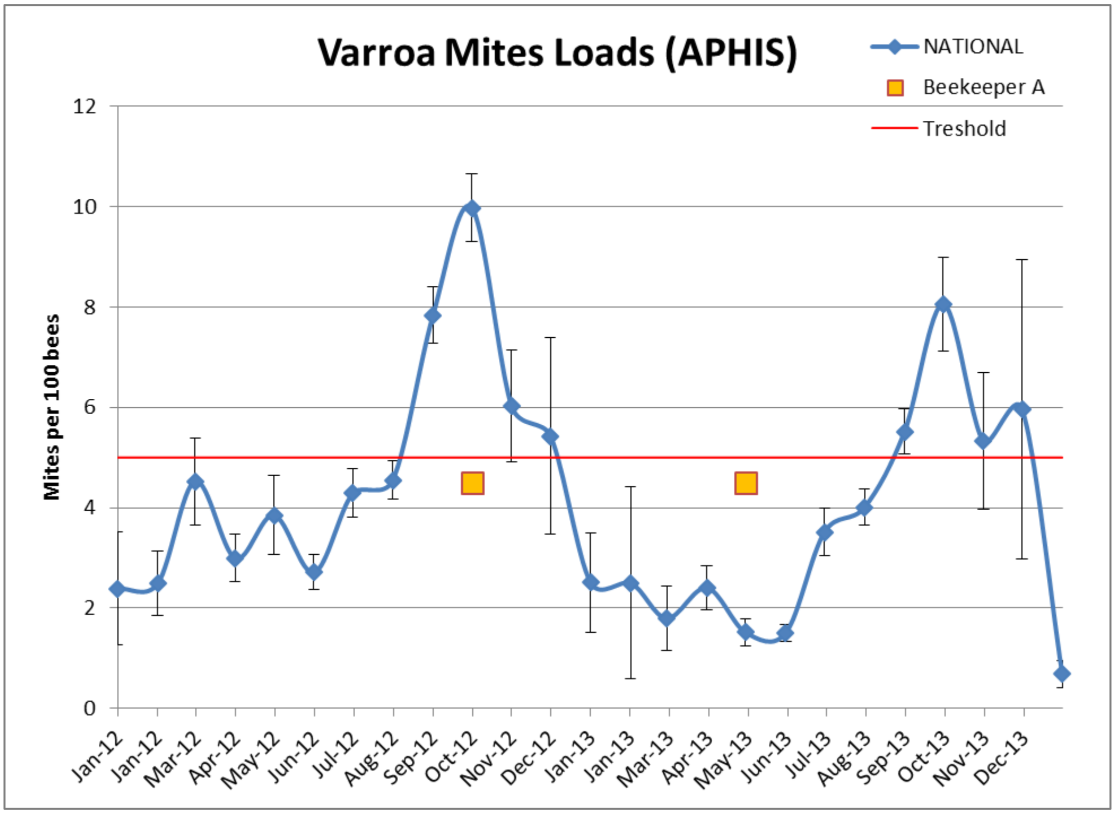

Figure 2. 2: Average *Varroa* Loads in the US (2012-2013).

Legend: The blue line represents *Varroa* mite loads observed from the *USDA APHIS National Honey Bee Disease Survey* 2012-2013 (n=1,515 operations sampled; data from (Traynor et al., 2016b)), averaged by month of observation (with error bars as standard errors). The two orange squares represent fictitious samples sent in by a beekeeper (used in the discussion above).

Illustration 2. The National Honey Bee Disease Survey (NHBDS), funded by USDA APHIS (Animal and Plant Health Inspection Service), is an example of surveillance program designed to ensure early detection of invasive pests (i.e. *Tropilaelaps clareae* mites) which are not presently found in the U.S. At the same time, this survey effort provides an opportunity to describe the prevalence and load of pathogens and parasites across the country and over time. One parasite monitored was the *Varroa* mite. In Figure 2.2 the blue line represents the trend of *Varroa* mite loads in the US throughout the 2012-2013 seasons. This graph shows the cyclic nature of the infestation loads, with a peak in end of summer to fall. In this context, let us imagine a beekeeper monitoring mites who observes 4.5 mites per 100 bees. Such a load is rather high, very close to the threshold of 5 mites per 100 bees which is sometimes referred to as the damaging level of mites in a colony. However, depending on the time of the year the interpretation will vary considerably. If the sample was taken in October, the NHBDS trend curve allows us to compare this single result to an estimated average load of 10 mites per 100 bees in the US population at that time. This does not let us know if that level is acceptable, as the survey did not collect information about survivorship of those colonies, but it allows us to say that this beekeeper's sample would be below the norm. However, if the sample was taken in May, though it is still below the same threshold of 5 mites per 100 bees, we can see that it is far above the levels reported in the US for that time of the year. Using only a threshold criterion would have failed to detect this anomaly, while comparing it to a descriptive study of *Varroa* loads in the US gave us a more complete and useful story.

Box 2: Sensitivity and specificity

Whenever a test is performed to identify a disease (presence or absence), there is a certain risk of error in the diagnostic. Sometimes the test will fail to identify the presence of the disease (false negative), or sometimes the test will incorrectly detect the presence of the disease (false positive). A good test method should minimize those errors. How good a test is, is quantified as the sensitivity and specificity of a diagnostic test.

The **sensitivity** of a test is its ability to correctly identify samples with the disease. A highly sensitive test minimize false positives. In other words, if a highly sensitive test identify a sample as negative, we are nearly certain it is indeed negative (disease free).

The **specificity** of a test is its ability to correctly identify samples without the disease. A highly specific test minimize false negatives. In other words, if a highly specific test identify a sample as positive, we are nearly certain it is indeed positive (diseased). Ideally, we would want all our diagnostic tests to be both highly sensitive and specific, but that is usually something of a tradeoff.

Identification of risk factors in honey bee health

While descriptive studies explain the prevalence and load of disease, analytical studies aim to identify and quantify the effects of exposure variables (or **risk factors)** on the prevalence of disease. Typically, epidemiologists look for association between exposure to a risk factor and a disease outcome by comparing populations with different exposures and see how they fare in respect to the disease of interest. Once identified, modifying risk factor exposure is the corner stone of preventive programs.

Illustration 3. An example of cross-sectional study was recently completed in Argentina. Researchers quantified the *Varroa* loads in colonies and also asked beekeepers about the management practices they used. The results showed that colonies with a mite load of 3 or more mites per 100 bees were 4.9 times more likely to die over the winter (Giacobino et al., 2015a) compared to colonies with mite loads below 3 mites per 100 bees. Beekeepers who did not monitor mite loads after they applied treatment, or did not requeen colonies the previous year were also more likely to experience higher rates of colony mortality.

It is important to remember that *association* (correlation) is not the same as *causation*. Most epidemiological studies are **observational** rather than experimental. This means that they take advantage of “natural experiments” in which the exposure (and sometimes the outcome) has already occurred, or occurs without the intervention of the researcher. Such “natural experiments” provide no guarantee that the two groups being compared are identical in all aspects other than the exposure/lack of exposure of interest. Experimental studies, on the other hand, try to ensure that all aspects are similar before applying the exposure themselves to a random subset of the experimental subjects. Epidemiologists strive to identify and control for all extraneous variables (“confounders”) that may correlate in unexpected ways with the observed results. Whenever possible, confounders are accounted for when analyzing results from observational studies, because, if unchecked, they can bias the interpretation of the results. Even when cofounding variables are identified and controlled, scientists rarely identify risk factors as “causal” of an outcome without experiment-based evidence of these associations. Observational studies can also serve as a basis for identifying the origin (etiology) of new problems and for helping to formulate hypothesis for later experimental testing.

Illustration 4. A recent study set out to document risk factors associated with increased risk of colony mortality in 3 migratory beekeeping operations (vanEngelsdorp et al., 2013b). The researchers found that "queen events" (evidence of a queen replacement or queen failure) was associated with an increased risk of colony death in the short term (~50 days following the event). In this study, "queen events" were the exposure variable of interest, and "colony death" the disease, or outcome of interest. This is an example of observational (non-experimental) study as the researcher did not induce any of the queen events to follow their impact on the mortality rate. Instead, they took advantage of natural events, carefully recorded, to get insights in honey bee health mechanisms.

Measures of association

When designing studies, epidemiologists plan how they will select the subjects, follow them over time, and analyze their results. This is referred to as the "study design". There are many different study designs meant to identify possible associations between exposure and disease outcome. Three of the most widely used of these study designs include *cohort* studies, *case-control* studies, and *cross-sectional* studies (and are illustrated and explained in Figures 2.3-2.5).

Each study design has its strengths and weaknesses, and a detailed explanation of these differences is beyond the scope of this chapter. At the core, these differences revolve around how the subjects of the study are selected (either based on their disease or exposure status), which affects how results should be interpreted. Either way, they compare the “risk” (or probability) of disease occurring in two different groups – one exposed to the risk factor and the other not – from the same population. The results are usually presented as relative risk (also called **risk ratio**, RR) or relative odds (also called **odds ratio**, OR) (see Figures 2.3-5 for details).

A RR of OR of 1 indicates that both groups show similar risks of disease, irrespective of the level of the exposure. So the exposure seems unassociated with the disease. A RR or OR greater than 1 indicates that the group exposed shows higher levels of disease, so the exposure is associated with the disease. A RR or OR less than 1 indicates that the group exposed shows lower levels of disease, which suggest the exposure reduced disease prevalence. The greater the magnitude of the difference, the greater the “strength of the association”: the more one group shows an increased risk for the disease compared to the other group.

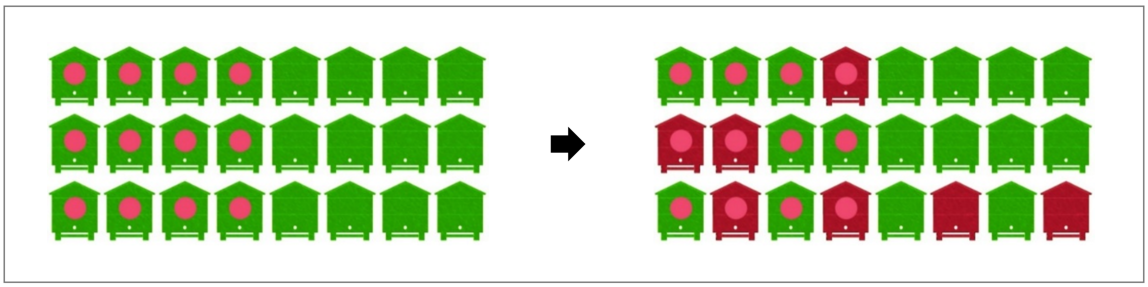

Figure 2. 3: Fictitious cohort study.

Legend: Green colonies = disease absent; Red colonies = disease present; Dot = exposure present (before the start of the study) to a certain factor X. The arrow represents the passage of time. In a cohort study, a group of disease-free subjects (the cohort) is selected based on their exposure status (both exposed and non-exposed) to a risk factor of interest (left panel). All of the hives would then be followed for a set period of time and the incidence of disease in both the exposed and unexposed subgroups are monitored (right panel). This kind of study allows for the calculation of relative risk (RR) which is the ratio of incidence of disease (or risk) in the exposed population (R_{Exp}) divided by the incidence of disease in the unexposed population (R_{NExp}). In other words, it is a measure of the increased (or decreased) risk subjects have of developing a disease after being exposed to a risk factor. For this example, the probability, or risk, of a colony in the exposed group (with dots in the figure) to develop the disease during the study period would be 0.42 (5 on 12). Not all colonies exposed will develop the disease. This rate should be compared to the risk for colonies without a known exposure (without dots in the figure) to develop the problem, which is about 0.17 (2 on 12). In this example, the disease does also occur in colonies that were not exposed to the risk, but at much lower rate than for exposed colonies. The Relative Risk is calculated at 2.47 (RR= R_{Exp} / R_{NExp} = 0.42/0.17), which represent an increased risk of 147% ((2.47-1)x100). This means that exposed colonies were 147% more likely to become diseased than non-exposed colonies. The conclusion is that colonies exposed to the product X present a higher risk of developing the disease than the non-exposed colonies, and the recommendation would be that beekeepers avoid the use of product X.

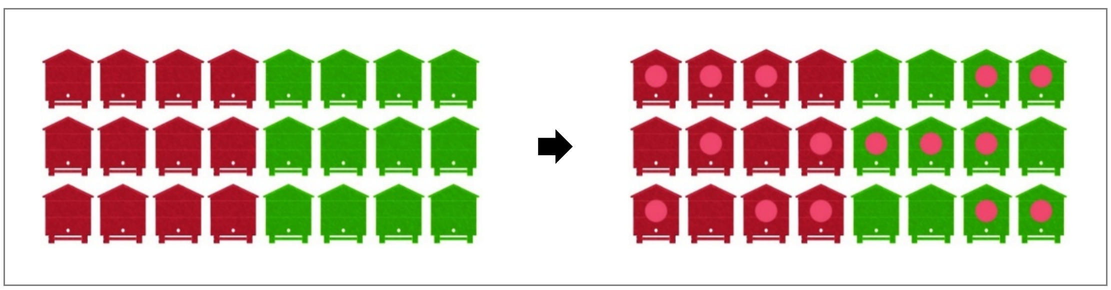

Figure 2. 4: Fictitious case control study.

Legend: Green colonies = disease absent; Red colonies = disease present; Dot = exposure present (before the start of the study) to a certain factor X under study. The arrow represents the passage of time. In a case control study, a group of diseased subjects (the cases) are compared to a group of disease-free subjects (the controls) (left panel). Ideally, control subjects resemble the disease subjects as closely as possible. Their history is then compared (usually through surveys, or tests are performed) to establish which of them were exposed to the risk factor under study (right panel). Because the proportion of cases to controls is unlikely to be representative of their proportion in the source populations (we actively looked for the diseased colonies), it would not be fair to calculate totals, probabilities and risk ratios. However, we can compare odds: the probability that some event will occur compared to the probability that it will not occur. Odds ratios (OR) are tricky and easily misinterpreted, even by professionals.

For this example, of the 24 colonies selected based on their disease status (12 diseased and 12 controls non-diseased), 15 of the colonies were found to have been exposed to the factor X under study (with dots in the figure). The odds of an exposed colony being a case are 8 to 7. The odds of a non-exposed colony being a case are 4 to 5. The Odds Ratio (OR) would therefore be 1.4 (8/7 divided by 4/5). We would be interpreted as a 40% increase of odds of developing the disease in the exposed population compared to the non-exposed population. When the disease is uncommon, OR will be reasonably good estimates of Risk Ratio and can be interpreted similarly.

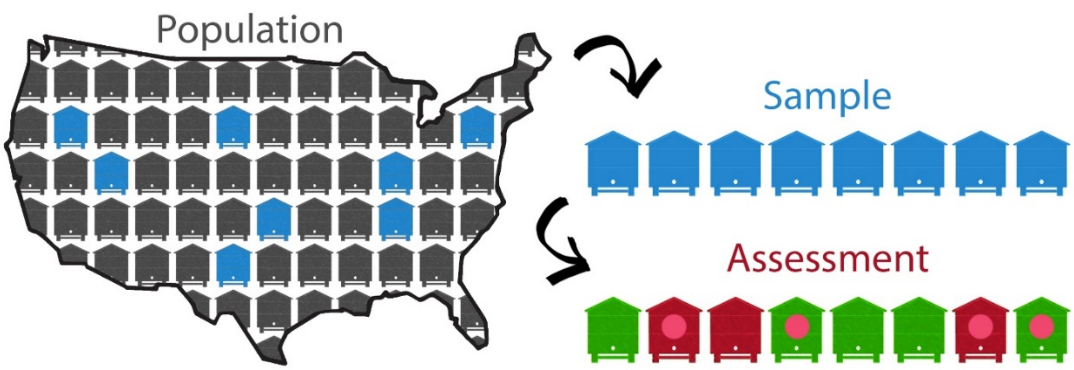

Figure 2. 5: Basic design of a cross sectional study.

Legend: In cross sectional studies, subjects are first selected according to a particular sampling scheme (random, convenience or other), without regard for their disease or exposure status. They are referred to as the **sample**. Then both exposure status and outcome status are assessed at the same time. Sometimes, the investigators try to determine past levels of exposure through retrospective surveys. For instance, they might be able to glean significant information from beekeeping records. Those studies have the advantage that both outcome and exposure levels are representative of their true prevalence in the target population (subjects exposed and/or diseased are not more likely to be selected). Another variant is to follow the same population over time in a series of snapshots of cross-sectional studies. While cohorts start with disease-free subjects and investigate *incidence* of problems (i.e. development of new cases), cross-sectional studies focus on the *prevalence* within (i.e. the existing cases) a population at the time of the study. Therefore, in cross-sectional studies, the measure of risk is based on the prevalence of disease outcome in groups that have had or have not had an exposure to the risk factor of interest. This is expressed as a relative risk (RR), and is calculated exactly like the relative risk in Cohort studies. The difference however, is that in this case relative risk relates to the risk of having the disease rather than the risk of developing it. This is an important distinction when interpreting the results: if a factor improves the survivorship of diseased colonies compared to non-exposed diseased colonies (but without curing them), it could be misinterpreted as being associated with the disease, because most disease colonies still alive would be most probably exposed (the others being already lost).

Illustration 4 (continued). The study of migratory operations is an example of cohort study where groups with different exposure histories (queen events) were followed and compared in terms of disease incidence (in this case, colony mortality). A total of 284 inspections were performed, from which 35 showed signs of a queen event. The colonies were inspected again after ~50 days to determine the outcome status for the whole colony. The table of incidences is shown below. From it, we can determine that colonies that underwent a queen event showed a risk of 0.31 or 31% (R_{Exp} = 11/35) of dying over the next ~50 days. Colonies that did not experience a queen event showed a risk of 0.10 or 10% (R_{NExp} = 25/249) of dying over the next 50 days. In this study, the relative risk is calculated at 3.1 (RR= R_{Exp} / R_{NExp} = 0.31/0.10), which represent an increased risk of 210% ((3.1-1)x100). This means that the risk of dying for colonies who experienced a queen event were more than two times more likely to die than those colonies that did not experience a queen event (vanEngelsdorp et al., 2013b).

It is critical to remember that association is not causation, so it would be incorrect to say that the queen event caused the increase in colony loss. Based on this study it is not possible to determine if that queen events caused the increased mortality, or if some other factor caused colonies to die also caused an increase in queen events.

Significance of epidemiology for your beekeeping management

Before collecting any data, epidemiologists plan their experiments and decide which exposures and outcomes they will investigate. This is because the real world is complex. Multiple causes can exist for almost every outcome and every exposure variable can affect many different disease (Dohoo et al., 2003). Epidemiologists have to focus on a specific problem. Many times even minor unrecognized factors can dramatically impact outcomes. Colonies managed by different beekeepers will be subjected to very different regimens (equipment, feeding, treatment, migration…). Even within the same beekeeping operations, apiaries will differ between each other in terms of availability of resources. Further within the same apiary, colonies can experience very different microclimates (for instance, some colonies are predominantly in the shade while others in the sun). A careful study would try to control for these extraneous variables; for instance making sure all apiaries were all in full sun, so that any potentially cofounding effects are minimized.

Epidemiologists work at the population level, trying to estimate the difference the implementation of preventive or curative practices would have for the whole population. In some respects, epidemiologists ask “what if”. What if the risk factor associated with a disease was removed? How many fewer cases of the disease could we expect?

As epidemiologists deal with calculating the chance of something occurring or not, they cannot make predictions for individuals, rather they can make predictions at the population level. Thus, a large part of epidemiology involves the application of risk easement strategies in order to reduce disease prevalence for the whole population.

There is a common saying: “a poll is only as good as its sample size”. The same holds true for epidemiological studies. Whether the interest is in knowing the prevalence of a disease in a population or the strength of its association to an exposure, it is important that the sample is **representative** of the overall population. Populations have variability, and a good sample has the same variability. Epidemiologists usually convey this idea with a measure of uncertainty around their results, such as the **confidence intervals** (CI). Usually, the greater the sample size (the more subjects in the study), the smaller the CI around the estimate (the smaller the incertitude).

Illustration 2 (continued). The US National Honey Bee Disease Survey report (Traynor et al., 2016b), summarizing the results from 2009 to 2014, indicated that migratory beekeepers had significantly lower *Varroa* prevalence than stationary operations (84.9% [81.4-87.8%] vs. 97.0% [95.6-97.9%]). The estimates are followed by a bracket indicating the breadth of the confidence interval. Because those 2 intervals (the ones for stationary and for migratory) do not overlap, we are confident in saying their prevalence are significantly different.

Traditionally, statisticians employ a “95% CI.”, which indicates that, if we were to repeat the study 100 times, with 100 samples drawn randomly from the same population, and that a CI was calculated for each trial, 95% of those CI would contain the population’s true *Varroa* prevalence.

Current state of honey bee colony population and health

There are many ways to monitor honey bee health. One measure is the total numbers of managed honey bee colonies over time. Honey bee populations have increased globally by 64.7% since 1961, reaching a total of 81 million managed honey bee colonies in 2013 (Food and Agriculture Organization of the United Nations (FAO), 2015). This global increase is largely driven by increases in colony numbers in some regions of the world (Asia and South America) which masks significant decreases experienced in other regions, such as that documented in Europe (-20.3%, (Potts et al., 2010b)) and the US (-52.1%, vanEngelsdorp and Meixner, 2010), (see Figure 2.6). While total colony counts are good indicators of managed pollinator availability, they inadequately represent honey bee health. Managed honey bee colony population trends are mostly driven by socio-economic factors (such as number of beekeepers, price of honey, political disruption, etc.) (Aizen and Harder, 2009; Potts et al., 2010b; vanEngelsdorp and Meixner, 2010) rather than biological. Total colony counts, estimated once a year, ignore the beekeeper practice of replacing dead-outs to keep operational numbers up. Beekeepers divide healthy colonies and/or buy and install packages in order to replace dead out colonies or to increase operational size, so that the absolute number of colonies can be stable or even increasing year after year, even if colonies are subjected to high mortality rates (vanEngelsdorp et al., 2007). Because of the ability to replace dead out colonies quickly, which is particular to managed systems (as opposed to wild pollinators), honey bee health is better represented by measuring the rate of colony mortality over a defined time frame. In 2008, the COLOSS (Prevention of honey bee Colony LOSSes) network – formed of honey bee experts from Europe, North America and some other regions around the world – developed a standardized questionnaire to gather information about colony losses in an effort to enable comparison between participating countries (van der Zee et al., 2012). While at first these survey efforts focused on winter mortalities, more recent US efforts have included calculating summer loss rates as well. It has long been assumed that summer loss rates are minimal, however survey efforts have shown that in the US summer losses are not negligible (Steinhauer et al., 2014) and so should also be considered when attempting to describe the status of honey bee health. Over the last 10 years, the rate of honey bee losses over the winter in the US has ranged from 22.3% to 35.8%, averaging around 28%. Over the 6 years for which summer (as defined by the period between April and October) numbers are available, summer losses ranged from 16.2% to 25.3% and averaged 21% (vanEngelsdorp et al., 2007, 2008, 2010, 2011, 2012; Spleen et al., 2013; Steinhauer et al., 2014; Lee et al., 2015; Seitz et al., 2015; 2015-2016 results, in preparation). Those loss estimates are far above the levels beekeepers themselves judge acceptable (16%, average of 10 years).

The causes of high levels of managed honey bee colony losses are multiple, and probably interacting (Potts et al., 2010a). Honey bees face a very diverse array of threats (reviewed in Potts et al., 2010; vanEngelsdorp and Meixner, 2010), from diseases and parasites, to reduced quality and quantity of bee forage due to land-use change, climate change, contaminations by pesticides (applied both outside and inside the hive) and, at least for US populations, potential loss of genetic variability (but see Wallberg et al., 2014).

High levels of colony loss throughout the year seriously threaten the sustainability of beekeeping operations. Replacing dead colonies is costly, both directly (e.g. purchase of queens and bees) and indirectly, resulting from reduced productivity of split colonies. Weak and unhealthy colonies are also more costly to maintain as they need more feed, more frequent inspection and disease treatments. Weaker colonies also do not generate the same return as healthy strong colonies. Almond producers commonly have provisions in their pollination contracts that pay premiums for strong colonies while enforcing penalties for weak colonies. In fact some pricing schedules are now based on frame counts instead of the number of hives (Champetier, 2011).

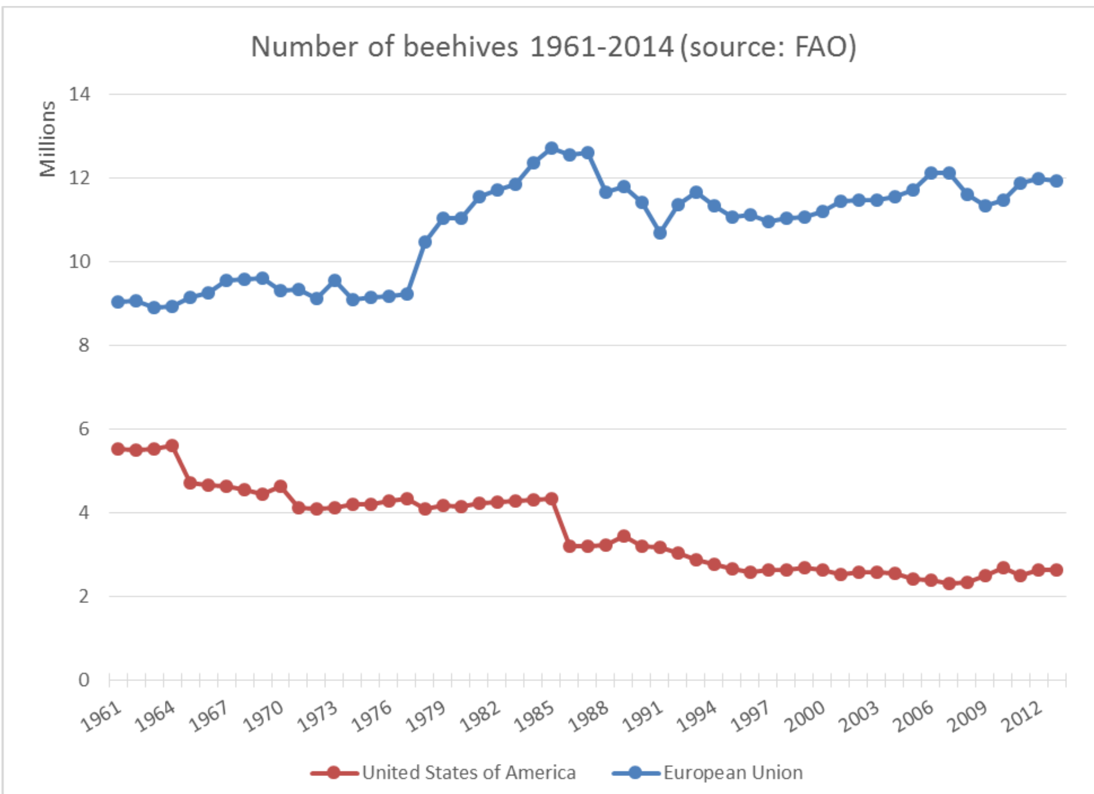

Figure 2. 6: Population trend.

Estimates of the total number of managed honey bee colonies in the United States and European Union between 1961 and 2014 (Food and Agriculture Organization of the United Nations (FAO), 2015).

Summary

Epidemiology emphasizes that health is a common good. By focusing research on health at the population level, epidemiology can make a great impact in improving health. Large scale epidemiological studies are important both to produce reliable accounts of the status of honey bee health but also to react efficiently to abnormal health events, develop and test hypotheses on disease etiology and to inform prevention and control strategies.

The same key principles that make epidemiological studies successful at population levels apply at apiary or operational levels and should be applied by every beekeeper. These recommendations include:

1) Carefully apply the preventive recommendations developed locally
2) Monitor disease levels as often as practical throughout the year
3) Compare the levels present in your own apiary to a quality baseline to detect abnormalities
4) Apply the proper recommended control strategies when problems are detected

5) Assess the efficacy of such control methods whenever they are used. This means always doing a recheck for the problem to be sure the control method(s) used were effective.

6) Always keep quality records and when possible participate in national surveys.

Chapter 3: A national survey of managed honey bee 2012-2013 annual colony losses in the USA: results from the Bee Informed Partnership

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Summary

For the past six years in which overwintering mortality of honey bee colonies has been surveyed in the USA, estimates of colony loss have fluctuated around one-third of the national population. Here we report on the losses for the 2012-2013 seasons. We collected data from 6,482 US beekeepers (6,114 backyard, 233 sideline, and 135 commercial beekeepers) to document overwintering mortality rates of honey bee colonies for the USA. Responding beekeepers reported a total 30.6% (95% CI: 30.16 – 31.13%) loss of US colonies over the winter, with each beekeeper losing on average 44.8% (95% CI: 43.88 – 45.66%) of their colonies. Total winter losses varied across states (range: 11.0% to 54.7%). The self-reported level of acceptable winter loss was 14.6%, and 73.2% of the respondents had mortality rates greater than this level. The leading self-identified causes of overwintering mortality were different according to the operation type; backyard beekeepers generally self-identified "manageable" factors (e.g., starvation, weak colony in the fall), while commercial beekeepers generally identified non-manageable factors (e.g., queen failure, pesticides) as the main cause of losses. For the first time in this series of surveys, we estimated mortality during the summer (total loss = 25.3% (95% CI: 24.80 – 25.74%), average loss = 12.5% (95% CI: 11.92 – 13.06%)). The entire 12-months period between April 2012 and April 2013 yielded a total loss of 45.2% (95% CI: 44.58 – 45.75%), and an average loss of 49.4% (95% CI: 48.46 – 50.43%). While we found that commercial beekeepers lost fewer colonies than backyard beekeepers in the winter (30.2% (95% CI: 26.54 – 33.93% vs 45.4% (44.46 – 46.32%) respectively), the situation was reversed in the summer where commercial beekeepers reported higher average losses than backyard beekeepers (21.6% (95% CI: 18.4 – 24.79%) vs 12.1% (11.46 – 12.65%)). These findings demonstrate the ongoing difficulties of US beekeepers in maintaining overall colony heath and survival.

Key words: Honey bee, overwinter, mortality, colony losses, USA, 2012-13

Short title: US honey bee colony mortality 2012-13

Introduction

The global population of honey bee (*Apis mellifera*) colonies has shown a 64% increase between 1961 and 2007 (Aizen and Harder, 2009), but not all regions have shown this expansion. For example, during the same period, both Europe (-26.5%) and North America (-49.5%) experienced severe reductions in their total number of managed colonies (Aizen and Harder, 2009). In the USA, managed colony numbers have declined by 61% from 1947 to 2008 (vanEngelsdorp and Meixner, 2010). A reduction in colonies is of concern because honey bees provide vital pollination services to agricultural crops. In the US, the value attributed to honey bees from crops directly dependent upon pollination has been was estimated at $11.68 billion by 2009 (Calderone, 2012). Although global crop yields have not yet been affected by pollinator decline (Aizen et al., 2008), the last 50 years of agriculture have been marked by a shift toward more pollinator-dependent crops (Aizen et al., 2008) that could soon exceed the pollination services provided by declining pollinator stocks (Aizen and Harder, 2009; Calderone, 2012). Efficient pollination has already been documented as a limiting factor for some crops at regional or local levels (Garibaldi et al., 2009; Klein et al., 2007).

The suspected factors behind this population decline are both biologic (Potts et al., 2010a; vanEngelsdorp and Meixner, 2010) and socio-economic (Potts et al., 2010b; vanEngelsdorp and Meixner, 2010). While longitudinal estimates of honey bee colony populations can help predict shortages or surpluses of pollination service, they do not fully capture the year-to-year mortality rates. Beekeepers can replace lost colonies by either dividing surviving colonies ('splitting') or creating new colonies (installing 'packages' of bees or nucs (nucleus colonies)) purchased from other beekeepers (vanEngelsdorp et al., 2007). Overwintering losses have been proposed as a more direct indicator of honey bee health (van der Zee et al., 2012; vanEngelsdorp et al., 2007).

For the past six years, overwintering mortality of honey bee colonies have been surveyed in the US, estimating total overwintering losses as 32%, 36%, 29%, 34%, 30% and 22% for the winters of 2006-7, 2007-8, 2008-9, 2009-10, 2010-11 and 2011-12, respectively (Spleen et al., 2013; vanEngelsdorp et al., 2007, 2008, 2010, 2011b, 2012). High overwintering mortality rates of honey bee colonies have also been reported in many other countries, mostly in Europe, but also in the Middle East, Africa, and Asia (Neumann and Carreck, 2010; Nguyen et al., 2010; Pirk et al., 2014; van der Zee et al., 2012). The underlying factors responsible for this mortality are unclear. There is, however, a general consensus that the causes of colony mortality are multi-factorial and interacting (Potts et al., 2010a; USDA NASS, 2002). When asking beekeepers to self-identify the reasons their colonies died, the most commonly reported factors have been queen failure, starvation, parasitic *Varroa* mites (*Varroa destructor*), and weak colonies in the fall (Spleen et al., 2013; vanEngelsdorp et al., 2007, 2008, 2010, 2011b, 2012). This is suggestive of the wide range of causes that can contribute to colony death, some of them resulting directly from beekeeping management strategies (vanEngelsdorp et al., 2012).

Continuing the series of winter loss papers produced by the Bee Informed Partnership (www.beeinformed.org), this study documents the 2012 - 2013 mortality rate of honey bee colonies for the US at national and state levels. We also compare rate of loss between varying sized operations, beekeeping activity, and by the symptom of having “no dead bees found in the hive.” This study further quantifies the prevalence of self-reported suspected causes of death from the beekeepers. For the first time, we additionally present estimates of summer, and annual (year-long) losses.

Materials and methods

A combined 2012-2013 winter loss and management survey was posted on an internet platform (SelectSurvey.com) and an invitation to participate in the survey was sent by email to national (n=2), state (n= 47), and local (n=466) beekeeping organizations. Invitations were also distributed through a beekeeping supply company’s email list (Brushy Mountain Bee Farm) and through honey bee brokers (n=20; for almond pollination in California). Advertisements were published in two beekeeping journals; *American Bee Journal* and *Bee Culture*, who forwarded the invitation to their subscription listservs (Catch the Buzz and ABF Alert). Previous years’ participants that had requested to be included in future surveys and individuals who indicated their wish to be contacted (by signing up on the beeinformed.org web site or at talks and meetings) received the invitation by email (n = 5,662). To increase recruitment, announcements were posted on web-forums and on social media websites (e.g., Facebook). All solicitations encouraged the recipient to forward the request to other beekeepers. Personal letters were also sent to the Apiary Inspectors of America (AIA), a majority of state extension apiculturists, club newsletters, and industry leaders.

Because our previous surveys showed a shortfall in the representation of commercial beekeepers, a more targeted strategy was used to increase large-scale beekeeper's participation. Paper versions of the survey (n=1,300) were mailed to large commercial beekeepers directly or through their state apiarists. At their request, we also extended the survey time by two weeks compared to previous years. Our recruitment method prevents us from calculating a response rate, as the total number of beekeepers contacted is unknown.

All the data analysed in this study were gathered through 18 questions (Box 1). To ensure consistency with other international estimates, core survey questions (1 to 13) were derived from the efforts of Working Group 1 of the international honey bee research network COLOSS (prevention of honey bee COlony LOSSes) (van der Zee et al., 2012). After answering this traditional "winter loss survey", participants were offered an optional survey ("management survey") from which this study estimates summer and annual losses.

The online survey was open from 29 March to 30 April 2013. The paper versions were distributed through mail on 13 March and all the completed surveys sent back before 30 April were integrated into the survey database.

The database was then edited for processing (i.e., replacing text with numbers – 2 instead of “two”) where appropriate, and filters were developed to exclude invalid responses from the analytical dataset. All obvious duplicate answers, all non-US entries (information from Survey Question 1), those with insufficient answers to calculate a valid winter or summer loss (between 0 and 100%), and obvious typing errors (e.g., number of colonies either non-integer or exceedingly large >80,000) were excluded from our analyses.

As in previous studies, beekeepers were assigned to 3 levels of operational size groups according to the number of colonies managed on 1 October 2012: beekeepers managing 50 or fewer colonies are referred hereafter and in the analyses as “backyard beekeepers”; those managing between 51 and 500 colonies as “sideline beekeepers”; and those managing 501 or more as “commercial beekeepers”.

Statistical analyses

Based on the numbers provided by the respondents, we calculated total and average colony losses, following the standard outlined by vanEngelsdorp et al. (2013a). Each beekeeper manages one operation, which may or may not be divided into several apiaries, comprised of various numbers of colonies. For each respondent, his or her individual operational overwintering loss was calculated using equation 1:

Equation 1:

$$Operational\ Winter\ Loss$$
$$= \frac{\#\ Colonies\ on\ 1\ Oct.\ 2012 + \ \#\ of\ increases - \#\ of\ reductions - \#\ Colonies\ on\ 1\ Apr.\ 2013}{\#\ Colonies\ on\ 1\ Oct.\ 2012\ + \#\ of\ increases - \#\ of\ reductions}\ x\ 100$$

Where the number of colonies on 1 October 2012 was provided by survey question #2; the number of increases between October 2012 and April 2013 by question #3; the number of reductions during the same period by question #4 and finally the number of colonies managed on 1 April 2013 by question #5. The numerator of this quotient is also referred to as the number of colonies 'lost' and the denominator as the number of colonies 'at risk' over the winter period.

From there, the total overwintering colony loss (TWL) of the population of concern was calculated as the quotient of the total number of colonies lost and colonies at risk in that population (Equation 2) while the average colony losses (AWL) was calculated as the mean of the individual operational overwintering loss (obtained from Equation 1) of all beekeepers in the population (Equation 3).

Equation 2:

$$TWL = \frac{Total\ \#\ Colonies\ lost\ in\ the\ population}{Total\ \#\ Colonies\ at\ risk\ in\ the\ population}\ x\ 100$$

Equation 3:

$$AWL = \frac{\sum Operational\ loss\ (see\ Equation\ 1)}{\#\ Operations}$$

For the first time in this series of surveys, we also calculated and report summer and annual losses. For each respondent, his/her individual operational summer (Equation 4) and annual loss (Equation 5) were calculated.

Equation 4:

$$Operational\ Summer\ Loss$$

$$= \frac{\#\ Colonies\ on\ 1\ Apr. 2012 +\ \#\ of\ increases\ -\#\ of\ reductions - \#\ Colonies\ on\ 1\ Oct. 2012}{\#\ Colonies\ on\ 1\ Apr. 2012\ + \#\ of\ increases - \#\ of\ reductions}\ x\ 100$$

Equation 5:

$$Operational\ Annual\ Loss$$

$$= \frac{\#\ Colonies\ on\ 1\ Apr. 2012 +\ \#\ of\ increases - \#\ of\ reductions - \#\ Colonies\ on\ 1\ Apr. 2013}{\#\ Colonies\ on\ 1\ Apr. 2012\ + \#\ of\ increases - \#\ of\ reductions}\ x\ 100$$

Where the number of colonies on 1 April 2012 was provided by survey question #16 and the number of increases and reductions that pertain to the relevant period: by question #17 for the number of increases between April 2012 and October 2012 for the calculation of summer loss and by the sum of question # 3 and # 17 for the number of increases during the whole year for annual loss. Similarly, the relevant number of reductions was provided by question #18 for summer loss and by the sum of question #4 and #18 for annual loss.

The **total colony loss** (for winter TWL, summer TSL, and annual TAL) corresponds to the accepted method for averaging proportions, but in our case it is highly influenced by the responses of commercial beekeepers who manage a disproportionate number of colonies in the US. It is, however, a more appropriate representation of the total loss experienced in an area.

The mean of the individual losses method used to calculate **average colony loss** (for winter AWL, summer ASL, and annual AAL) gives each beekeeper the same weight, independently of the size of its operation, providing more relevance when comparing sub-groups of beekeepers. Given the non-independence of colonies managed by the same beekeeper, averaging out the pseudo-replication is an accepted method for dealing with this kind of spatial pseudo-replication (Crawley, 2007). One disadvantage of this is that smaller operations can only have a limited number of loss outcomes and have a higher chance of zero or 100% loss than larger operations (vanEngelsdorp et al., 2011a).

Therefore, we calculated total loss (TL) for national and regional losses, while average colony loss (AL) was used to contrast sub-groups of beekeepers, using the Kruskal-Wallis rank sum test and its follow-up Mann-Whitney U test (also called Wilcoxon Rank Sum test). Those tests compare two (or more) vectors of numeric data for a difference in their medians, without assuming normal distributions, but assuming that the vectors share an identically shaped distribution.

The 95% confidence intervals (95% CI) for total loss (TL) were calculated using the standard outlined by vanEngelsdorp et al. (2013a) using a glm model (of family quasibinomial) to account for the structure of the data (R Development Core Team, 2009; code provided by Y Brostaux and B K Nguyen). The confidence intervals for average loss (AL) were calculated using the general Wald formula (vanEngelsdorp et al., 2013a). The Wald formula is a normal approximation interval which is appropriate given the large sample size.

For the calculation of the number of colonies managed in each state, colonies belonging to beekeepers reporting managed colonies in more than one state were counted in each of those selected states, according to the practice used by the USDA National Agricultural Statistics Service (NASS) for their calculation of the state-level number of honey-producing colonies (USDA NASS, 2013). The percentage of colonies lost with the symptom of “no dead bees in the hive or apiary” (survey Question #7) was used to calculate the total number of colonies lost with that symptom after multiplication with the reported number of lost colonies. The ratios of beekeepers grouped by operation size who suffered losses with the symptom of “no dead bees in the hive or apiary” were compared using the Chi square test.

All analyses were performed using the statistical program R (version 3.0.1 (2013-05-16)). All statistical tests were two-sided and used a level of significance of $\alpha = 0.05$. Responses for any group containing fewer than five respondents were not published to protect the privacy of the respondents.

Box 1: The survey questions

The following questions pertain to any losses you may have suffered over the winter (defined as the period between Oct 1 2012 and April 1 2013).

1. In what state(s) did you keep your colonies in between April 2012 - April 2013?*

    Multiple choice question, multiple selection allowed.
    Possible answers presented all US States, the District of Columbia, Puerto Rico and an “other” category to specify in open entry.

2. How many living colonies did you have on October 1, 2012?*
    A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).

    Numeric entry (positive integers).

3. How many splits, increases, and / or colonies did you make / buy between October 1, 2012 and April 1, 2013?*
    (increases surviving on April 1, 2013 should have been included in the total provided in the question above.)

    Numeric entry (positive integers).

4. How many splits, increases, and / or colonies did you sell / give away between October 1, 2012 and April 1, 2013?*

    Numeric entry (positive integers).

5. How many living colonies did you have on April 1, 2013?*
    A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).

    Numeric entry (positive integers).

6. Is this year's winter loss higher or lower than last year?
   - ❍ Higher
   - ❍ Lower
   - ❍ Same
   - ❍ Don’t Know
   - ❍ Did not keep bees last year

   Multiple choice, single selection allowed.

7. What percentage of the colonies that died between October 1st and April 1st were lost without dead bees in the hive or apiary?

   Percentage: The value must be between 0 and 100, inclusive.

8. What percentage of loss, over this time period, would you consider acceptable?

   Percentage: The value must be between 0 and 100, inclusive.

9. In your opinion, what factors were the main cause (or causes) of colony death in your operation between October 1, 2012 and April 1, 2013? Select all that apply.
   - ❐ Queen failure
   - ❐ Starvation
   - ❐ Varroa mites
   - ❐ Nosema disease
   - ❐ Small Hive Beetles
   - ❐ Poor wintering conditions
   - ❐ Pesticides
   - ❐ Weak in the fall
   - ❐ Colony Collapse Disorder (CCD)
   - ❐ Don’t know
   - ❐ Other, please specify:

   Multiple choice question, multiple selection allowed.

10. What percentage of your hives did you send to or move into California almond orchards for pollination?

    Percentage: The value must be between 0 and 100, inclusive.

11. How many times, on average, did you move your colonies last year?

    Numeric entry (positive integers)

12. In what zip code is your operation based (optional)?

13. Would you be willing to be contacted by our survey team in order to participate in other honey bee related surveys and review this survey?
    - ❍ Yes
    - ❍ No

    Multiple choice, single selection allowed

End of Winter Loss Survey

(…)

14. What was the largest number of living colonies you owned between April 1, 2012 and April 1, 2013?

	A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).
	Numeric entry (positive integers).
15.	What was the smallest number of living colonies you owned between April 1, 2012 and April 1, 2013? A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).
	Numeric entry (positive integers).
16.	How many living colonies did you have last spring (on April 1, 2012)?* A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).
	Numeric entry (positive integers).
17.	How many splits, increases, and / or colonies did you make / buy between April 1, 2012 and October 1, 2012?* "Increases" include successfully hived swarms and/or feral colonies. A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).
	Numeric entry (positive integers).
18.	How many splits, increases, and / or colonies did you sell or give away between April 1, 2012 and October 1, 2012?* A colony is a queen right unit of bees that include full size colonies and queen right nucs (do NOT include mating nucs).
	Numeric entry (positive integers).

Box 1: Questions as presented to the participating beekeepers and associated validation rules. Questions 1-13 are consistent to the survey questions developed by COLOSS. Participants who accepted to continue to the second part of the survey were presented with questions 14-18 (among others). The * indicates required questions that would not allow a blank response on the online survey.

Results

National losses

Average and total losses

The survey recorded 6,876 responses, from which 200 duplicates and 55 non-US residents were removed. From there, 3 subsets were created. The winter loss subset was reduced by an additional 139 responses for missing or invalid information needed for the calculation of winter loss (numbers leading to a negative or over 100% loss, zero colonies at the start of the period or an obvious typing error). All analyses regarding winter loss were performed on the remaining 6,482 valid respondents. Similarly, two other subsets of responses were created by filtering out 2,440 responses for missing or invalid information needed for the calculation of summer loss and 2,192 responses for annual loss, leaving an analytical sample size of 4,181 for summer loss and 4,429 for annual loss.

On 1 October 2012, those 6,482 respondents managed a total of 635,971 living colonies, representing 25.5% of the estimated 2.491 million honey-producing colonies managed in the US in 2012 (USDA NASS, 2013). The same 6,482 beekeepers reported managing 520,965 colonies on 1 April 2013, after having made or bought a total of 145,581 colonies and having sold a total of 30,437 colonies. According to those numbers, we calculated a total overwintering loss of 30.6% (TWL; 95% CI: 30.16 – 31.13%) of the US managed honey bee colonies, while individual respondent beekeepers lost on average 44.8% (AWL; 95% CI: 43.88 – 45.66%) of their colonies over the winter 2012-2013 (see Table 3 - 1). Approximately 24% (99.1% of which were backyard beekeepers) reported no (zero) overwintering colony loss. We also asked beekeepers to directly compare their winter losses to the previous year (Question 6). Of the 6,193 beekeepers who responded to this Question, 1,123 did not keep bees the previous year. Of the remaining beekeepers who did keep bees the previous year, 52.3% (n=2,651) indicated that they lost more colonies over the 2012 – 2013 winter than the previous year.

The 4,181 beekeepers who provided valid responses for the calculation of loss between 1 April 2012 and 1 October 2012 (hereafter referred to as "summer" loss) managed a total of 509,038 colonies at the start of the period, increased their operation by adding a total of 234,454 colonies, and sold a total of 23,979 during the same period. At the end of the period, on 1 October 2012, they managed a total of 537,694 colonies, leading to a total summer loss of 25.3% (TSL; 95% CI: 24.80 – 25.74%) of the US managed honey bee colonies while individual respondent beekeepers lost on average 12.5% (ASL; 96% CI: 11.91 – 13.06%) of their colonies over the summer 2012 (see Table 3 - 1). More than 58% of the respondents reported no (zero) summer colony loss.

Beekeepers (n=4,429) who provided valid responses toward an annual loss calculation managed a total of 520,168 colonies on 1 April 2012. These beekeepers increased their operations during that year by a total of 360,549 colonies and sold a total of 52,678 colonies over the course of the year. On 1 April 2013, these beekeepers reported that they managed a total of 454,072 colonies. We calculated a total annual loss of 45.2% (TAL; 95% CI: 44.58 – 45.75%) of the US managed honey bee colonies. On average, individual respondent beekeepers lost 49.4% (AAL; 95% CI: 48.46 – 50.43%) of their colonies over the one year period between April 1, 2012 and April 1, 2013 (see Table 3 - 1). Less than 16% of the respondents reported no (zero) annual colony loss.

Table 3 - 1: Self-reported 2012-2013 US colony loss (total and average loss (%) [95% CI]), showing the sample size (n) as the number of beekeepers having provided valid responses for each period of interest, the total number of colonies at the start of the respective period, the number of increases (+) and decreases (-) and the total number of colonies at the start of the respective period. Summer Loss represents loss between April 1, 2012 and October 1, 2012; Winter Loss between October 1, 2012 and April 1, 2013; and Annual Loss between April 1, 2012 and April 1, 2013.

		Total number of colonies managed on:						
Period	**n**	**04/01 /2012**		**10/01 /2012**		**04/01 /2013**	**Total Loss (%)**	**Average Loss (%)**
Summer Loss	4,181	509,038	(+234,454) (-23,979)	537,694		.	25.3 [24.8-25.74]	12.5 [11.91-13.06]
Winter Loss	6,482	.		635,971	(+145,584) (-30,437)	520,965	30.6 [30.16-31.13]	44.8 [43.88-45.67]
Annual Loss	4,429	520,168	(+238,020) (-27,973)	555,454	(+122,529) (-24,705)	454,072	45.2 [44.58-45.75]	49.4 [48.45-50.43]

Losses by operation type

The differences between total and average loss are explained by the difference in operation size from our respondents. Looking at the winter loss dataset (see Table 3 - 2), of the 6,482 participating beekeepers, 94.3% (n=6,114) qualified as “backyard beekeepers”, 3.6% (n=233) as “sideline beekeepers” and 2.1% (n=135) as “commercial beekeepers”. However, each of those operation types managed a total of 39,414 (6.2%), 35,937 (5.6%), and 560,620 (88.2%) colonies, respectively, on 1 October 2012. Therefore, more than 88% of the colonies represented in our study were managed by approximately 2% of the respondents.

Table 3 - 2: Self-reported 2012-2013 US colony loss by operation type (total and average loss (%) [95% CI]), showing the sample size (n) as the number of beekeepers having provided valid responses for each period of interest, the total (#Colonies (start)) and proportional (% Colonies (start) (%)) number of colonies at the start of the respective period for each of the operation type categories: backyard beekeepers (≤ 50 colonies), sideline beekeepers (>50 and ≤ 500colonies) and commercial beekeepers (>500 colonies).

	Operation Type	n	# Colonies (start)	% Colonies (start) (%)	Total Loss	Average Loss
Summer Loss	backyard	3,936	21,066	4.14	14.8 [14.22-15.37]	12.1 [11.46-12.65]
	sideline	141	23,204	4.56	18.3 [15.78-20.97]	17.8 [14.96-20.54]
	commercial	104	464,768	91.30	26.3 [23.42-29.24]	21.6 [18.4-24.79]
Winter Loss	backyard	6,114	39,414	6.20	42.7 [41.96-43.53]	45.4 [44.46-46.32]
	sideline	233	35,937	5.65	35.6 [32.44-38.85]	36.9 [33.56-40.26]
	commercial	135	560,620	88.15	29.6 [26.54-32.71]	30.2 [26.54-33.93]
Annual Loss	backyard	4,164	22,924	4.41	49.6 [48.75-50.5]	49.9 [48.91-50.98]
	sideline	156	25,218	4.85	45.3 [41.55-49]	42.7 [38.7-46.76]
	commercial	109	472,026	90.74	44.9 [41.36-48.49]	40.1 [36.17-44.04]

The 3 operation types differed significantly in their levels of seasonal losses (Kruskall-Wallis rank sum test: $\chi^2 = 124.5253$; 18.5757 and 15.881 for ASL, AWL and AAL, respectively, between Operation Types; all df = 2, all p-value < 0.001; see Fig.3.1 and Table 3 - 2 for loss estimates for each category). For all operation types, the winter period brought about a higher mortality than the preceding summer (Mann Whitney U test: U = 5765637, p-value < 0.001 for backyard beekeepers; U = 9128, p-value < 0.001 for sideline beekeepers and U = 5489.5, p-value < 0.05 for commercial beekeepers; see Table 3 - 2 for loss estimates). Where commercial beekeepers lost, on average, fewer colonies than backyard beekeepers over the winter (U = 487737, p-value < 0.001, see Table 3 - 3) (AWL 30.2% for commercial vs. 45.3% for backyard beekeepers, see Table 3 - 2), this was reversed in the summer, where commercial beekeepers experienced higher average mortality rate than backyard beekeepers (U = 122055, p-value < 0.001, see Table 3 - 3) (ASL 21.6% for commercial vs. 12.1% for backyard beekeepers, see Table 3 - 2).

Looking only at commercial and sideline beekeepers, we did not detect a difference between average winter loss (AWL) of beekeepers who indicated they moved at least part of their colonies to California almond orchards for pollination in 2012 and those who did not (see Table 3 - 4), nor between those who indicated that they moved their colonies at least once during the last year (“migratory”) and those who did not (see Table 3 - 4).

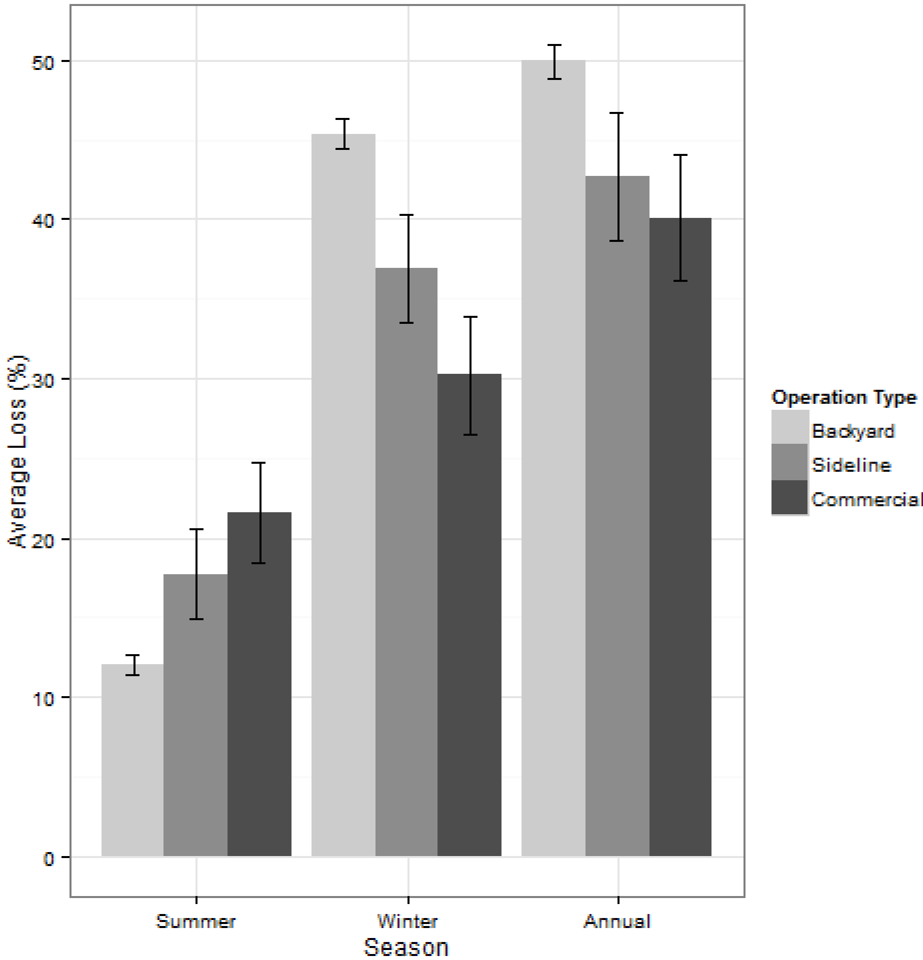


Figure 3. 1: Average seasonal colony loss by operation type for summer 2012, winter 2012-2013, and for the complete annual period from April 2012 to April 2013. Bars represent 95% CI.

Table 3 - 3: Comparison of average seasonal colony loss (ASL, AWL and AAL) among operation types, showing the value of the statistical tests (Mann-Whitney "U", or Wilcoxon Rank Sum test with continuity correction) and the associated p-value. The "*" indicates significance (α=0.05).

	Operation Type	n		Operation Type	n	U	p-value	
Summer Loss	Backyard	3936	vs.	Sideline	141	177880	< 0.0001	*
	Backyard	3936	vs.	Commercial	104	122055	< 0.0001	*
	Sideline	141	vs.	Commercial	104	6143.5	0.03003	*
Winter Loss	Backyard	6114	vs.	Sideline	233	776077	0.01867	*
	Backyard	6114	vs.	Commercial	135	487737	0.0002473	*
	Sideline	233	vs.	Commercial	135	17853	0.03071	*
Annual Loss	Backyard	4164	vs.	Sideline	156	365968	0.006803	*
	Backyard	4164	vs.	Commercial	109	264999	0.002615	*
	Sideline	156	vs.	Commercial	109	8773.5	0.6589	

Table 3 - 4: Comparison of average winter colony loss (AWL (%) [95%CI]) between sub-groups based on activities (for commercial and sideline beekeepers), showing the value of the statistical test (Mann-Whitney "U", or Wilcoxon Rank Sum test with continuity correction) and the associate p-value. Beekeepers are considered to be present for almond pollination in California if they indicated that they rented at least part of their operation when asked Question 10 of the survey. Beekeepers are considered "migratory" if they indicated at least 1 move during the year in Question 11 of the survey. We considered only commercial and sideline beekeepers for those 2 questions.

Factor	Selection	n	AWL (%) [95%CI]	U	p-value
Almond pollination (CA)	Yes	126	32.04 [28.43-35.65]		
	No	223	36.35 [32.8-39.91]	13370	0.4535
Migratory	Yes	238	33.81 [30.76-36.87]		
	No	108	35.08 [30.13-40.03]	12733.5	0.8911

Reported cause of overwintering loss

Of the 4,680 beekeepers who experienced at least some loss and answered Question #7, 38.8% (n=1,816) answered that at least some of their colonies died without visible dead bees in the hive or the apiary. Those beekeepers experienced a significantly higher average winter loss than beekeepers who did not report this symptom, whether we looked at the overall population (U=2806325, p-value < 0.01) or by specific operation types (U=2472222, 5976, and 1369 respectively; all p-values < 0.05; see Table 3 - 5). Of the 230,153 colonies lost during the winter, an estimated 51.3% (n=117,960) died with the symptom “no dead bees in the hive or apiary”. When reporting loss, commercial beekeepers were 2.32- and 1.30-times as likely to report this symptom as were backyard and sideline beekeepers (χ^2 = 113.9, df = 1, p-value < 0.001 and χ^2 =13.97, df = 1, p-value < 0.001, respectively).

Of the 4,892 respondents who reported a winter loss, 95.7% (n=4,681) recorded at least one answer to Question # 9 relating to self-reported main cause of colony death overwinter. Respondents could select multiple answers. Of the 4,681 respondents, 28.7% (n=1,344) indicated that they did not know the cause of death of the colonies that died in their operation (see Table 3 - 6). Those beekeepers lost over the winter, on average, 68% of their colonies (see Table 3 - 6); significantly more than those who lost colonies and identified at least one reason for their loss (AWL = 55.6 %, U = 2769497, p-value < 0.001, see Table 3 - 6).

Overall, the most frequently self-reported causes of death included: colony weak in the fall, starvation, queen failure, and *Varroa* mites (see Table 3 - 6). This list is highly biased towards backyard beekeeper’s responses. When accounted separately, commercial beekeepers have a contrasting list of “top” self-reported cause of death (see Fig. 3.2): their most frequently self-reported causes of death included queen failure, *Varroa* mites, pesticides, and Colony Collapse Disorder (CCD).

Survey respondents who selected poor wintering conditions, CCD, or pesticides as a main cause of winter colony loss suffered significantly higher losses on average than respondents who did not select these items (U=1857328, 1241739, and 877497, respectively; all p-values < 0.05; see Table 3 - 6). Conversely, beekeepers who selected weak in the fall, starvation, queen failure, *Varroa* mites, or nosema (*Nosema apis* or *Nosema ceranae*) as a factor contributing to their winter colony loss experienced significantly lower losses on average than respondents who did not select those factors (U=2197083, 2078126, 1662428, 1867732, and 593141, respectively; all p-values < 0.05; see Table 3 - 6).

Table 3 - 5: Average winter colony loss (AWL (%) [95%CI]) by CCD symptom and operation type, showing the value of the statistical test (Mann-Whitney "U", or Wilcoxon Rank Sum test with continuity correction) and the associated p-value. Presence of CCD symptom was attributed to the beekeepers who reported that at least part of their dead colonies did not show any dead bees in the hive or in the apiary. The "*" indicates significance (α=0.05).

Operation Type	CCD symptom	n	AWL (%) [95%CI]	U	p-value	
All	Present	1816	61.58 [60.22-62.93]			
	Absent	2864	57.41 [56.27-58.55]	2806325	< 0.0001	*
Backyard	Present	1582	65.09 [63.67-66.5]			
	Absent	2773	58.33 [57.18-59.48]	2472222	< 0.0001	*
Sideline	Present	133	41.03 [36.92-45.14]			
	Absent	72	31.54 [25.45-37.63]	5976	0.003402	*
Commercial	Present	101	33.63 [29.59-37.68]			
	Absent	19	21.56 [10.98-32.14]	1369	0.003279	*

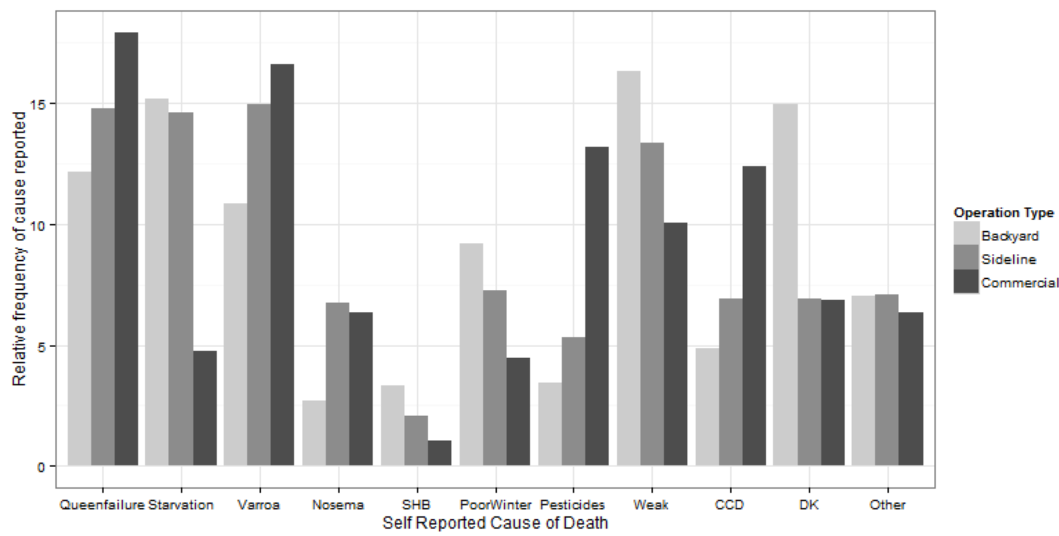


Figure 3. 2: Frequency of self-reported cause of colony death by operation type

Shows the frequency of selection from beekeepers of each factor as a main cause of death for colonies that died in their apiaries over the winter.

Table 3 - 6: Average winter colony loss (AWL (%) [95%CI]) by self-reported cause of death, showing the value of the statistical test (Mann-Whitney "U", or Wilcoxon Rank Sum test with continuity correction) and the associated p-value. Contrasts between groups of beekeepers having selected or not the respective factor as main cause of death for their reported winter losses. The "*" indicates a significant (α=0.05) difference between the 2 sub-groups.

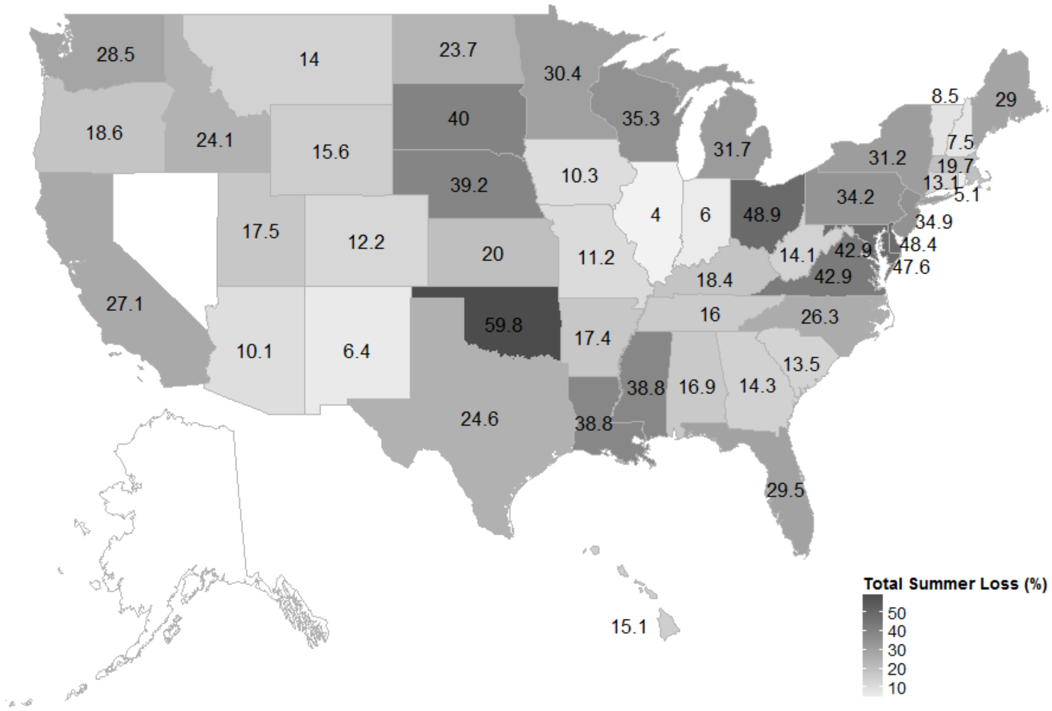
	Factor selected		Factor not selected				
Factor	**n**	**AWL [95%CI]**	**n**	**AWL (%) [95%CI]**	**U**	**p-value**	
Weak in the fall	1,516	56.13 [54.62-57.64]	3,165	60.58 [59.50-61.65]	2197083	< 0.0001	*
Starvation	1,406	55.4 [53.86-56.94]	3,275	60.74 [59.68-61.8]	2078126	< 0.0001	*
Queen Failure	1,199	51.1 [49.41-52.8]	3,482	61.90 [60.89-62.91]	1662428	< 0.0001	*
Varroa	1,082	57.41 [55.65-59.17]	3,599	59.65 [58.64-60.66]	1867732	0.03989	*
Poor Winter	850	65.26 [63.31-67.22]	3,831	57.78 [56.8-58.75]	1857328	< 0.0001	*
CCD	507	67.36 [65-69.73]	4,174	58.14 [57.2-59.07]	1241739	< 0.0001	*
Pesticides	379	63.02 [60.17-65.86]	4,302	58.79 [57.87-59.71]	877497	0.01267	*
SHB	299	59.94 [56.59-63.29]	4,382	59.08 [58.17-59.99]	667709.5	0.5736	
Nosema	298	54.33 [51.24-57.43]	4,383	59.46 [58.55-60.37]	593141	0.007354	*
Don't know	1,344	68.01 [66.48-69.54]	3,337	55.56 [54.52-56.60]	2769497	< 0.0001	*

Acceptable overwintering losses

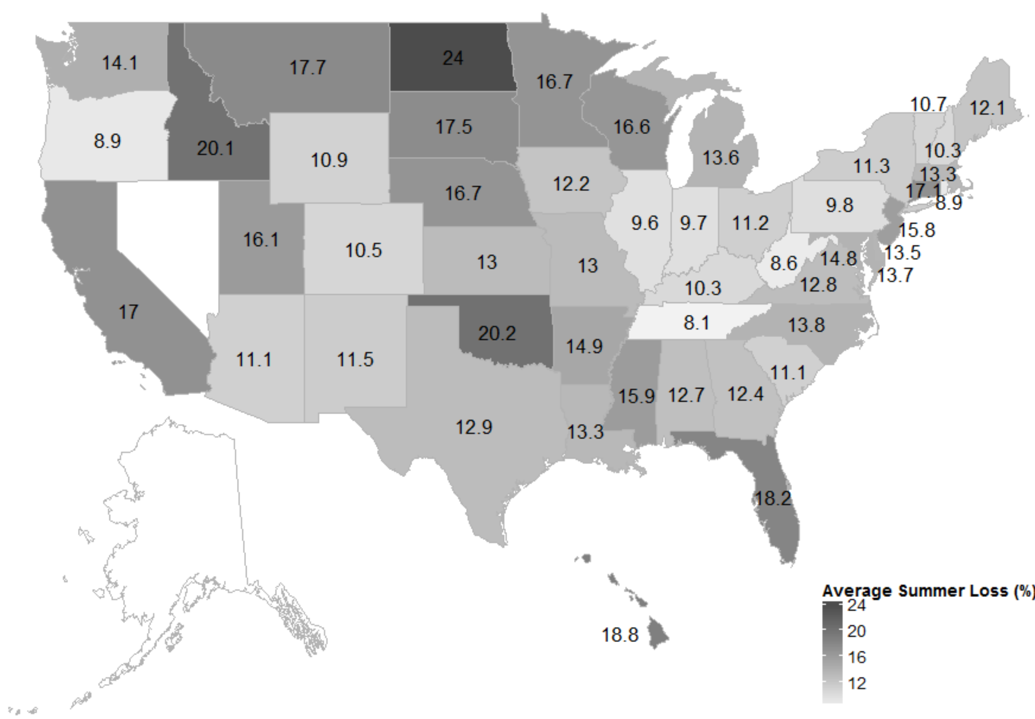
For the question “What percentage of loss, over this time period, would you consider acceptable?”, responding beekeepers (n= 5,876) reported on average that they would consider a winter loss of 14.6 % (95% CI: 14.21-15.09) to be acceptable. The answer provided was very similar across operation types (backyard beekeepers: n=5,533 reported 14.6 % (95% CI: 14.15 – 15.08); sideline beekeepers: n=216 reported 15.0 % (13.59 – 16.36) and commercial beekeepers: n=127 reported 15.7% (95% CI: 13.66 – 17.8)). 73.2% (n=4,300) of the responding beekeepers suffered losses higher than this average acceptability level. When compared to their individual acceptable level, 70.2% (n=4,122) of the beekeepers experienced winter loss above the level they judge acceptable.

State losses

The number of respondents to the survey was highly variable across states (see Table 3 - 7, number of operations). The total and average seasonal losses calculated from beekeepers’ reports also varied substantially across states. The total winter loss (TWL) experienced by a state ranged from 11.0% to 54.7% with a median of 27.0% (see Table 3 - 7 and Fig. 3.5), while total summer loss at the state level ranged from 4.0% to 59.8% with a median of 20.0% (see Table 3 - 7 and Fig. 3.3). Between April 2012 and April 2013, the total annual loss experienced by US states ranged from 18.8% to 73.5% with a median of 43.2% (see Table 3.7 and Fig. 3.7). See Table 3 - 7 for the average winter, summer and annual loss reported by individual respondents for each state (AWL (see Fig. 3.6), ASL (see Fig. 3.4) and AAL (see Fig. 3.8)).



<u>Figure 3. 3:</u> Total summer colony loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which they reported managing colonies. Data for states with fewer than five respondents are withheld.



<u>Figure 3. 4:</u> Average summer colony loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which

they reported managing colonies. Data for states with fewer than five respondents are withheld.

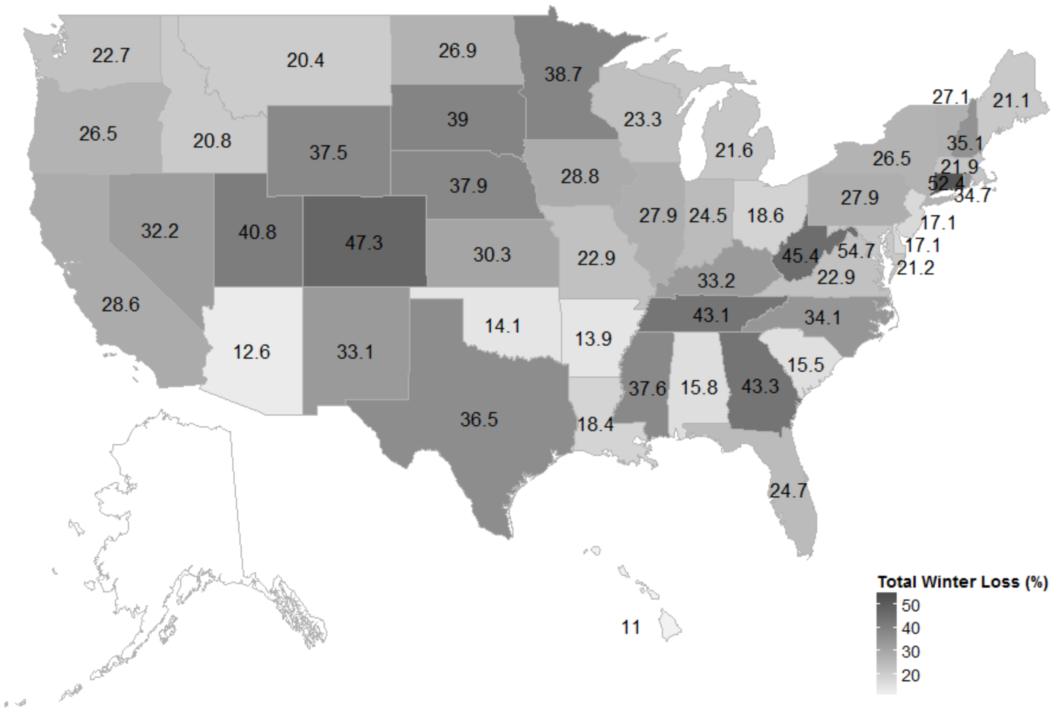


Figure 3. 5: Total winter colony loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which they reported managing colonies. Data for states with fewer than five respondents are withheld.

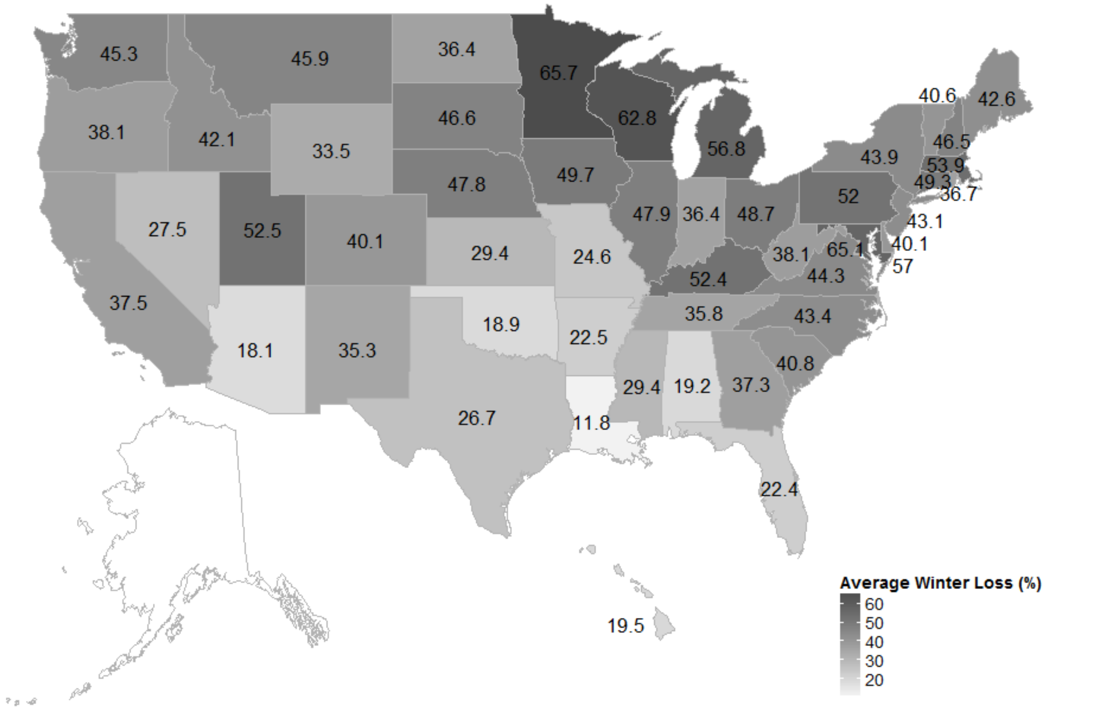


Figure 3. 6: Average winter colony loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which they reported managing colonies. Data for states with fewer than five respondents are withheld.

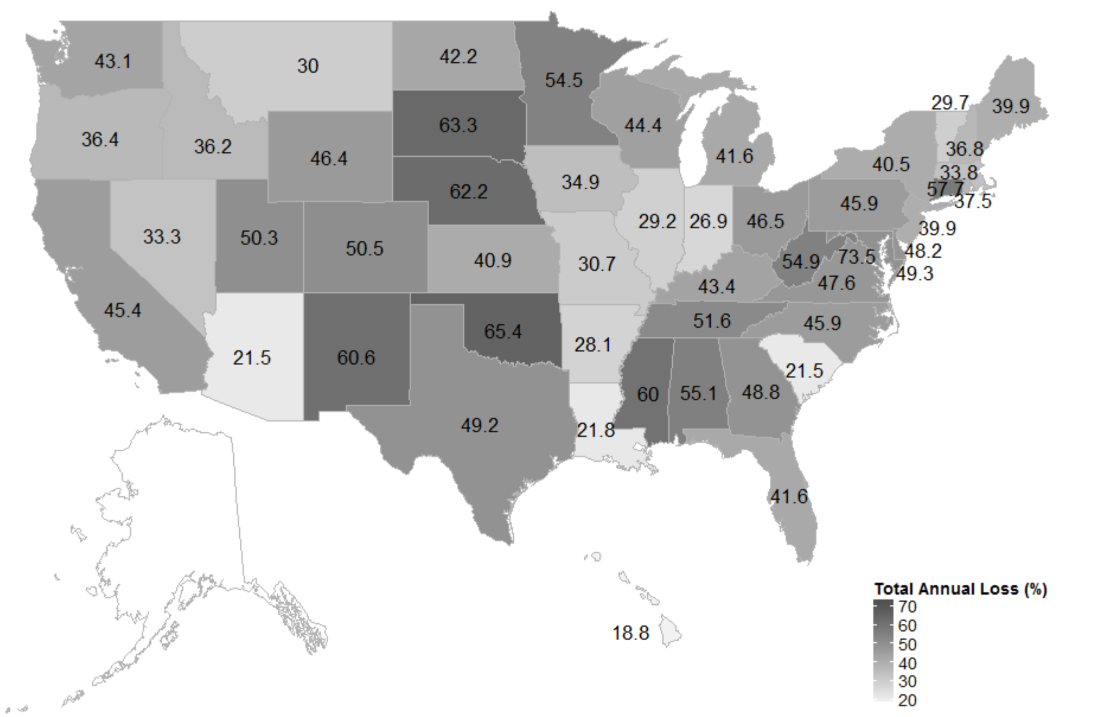
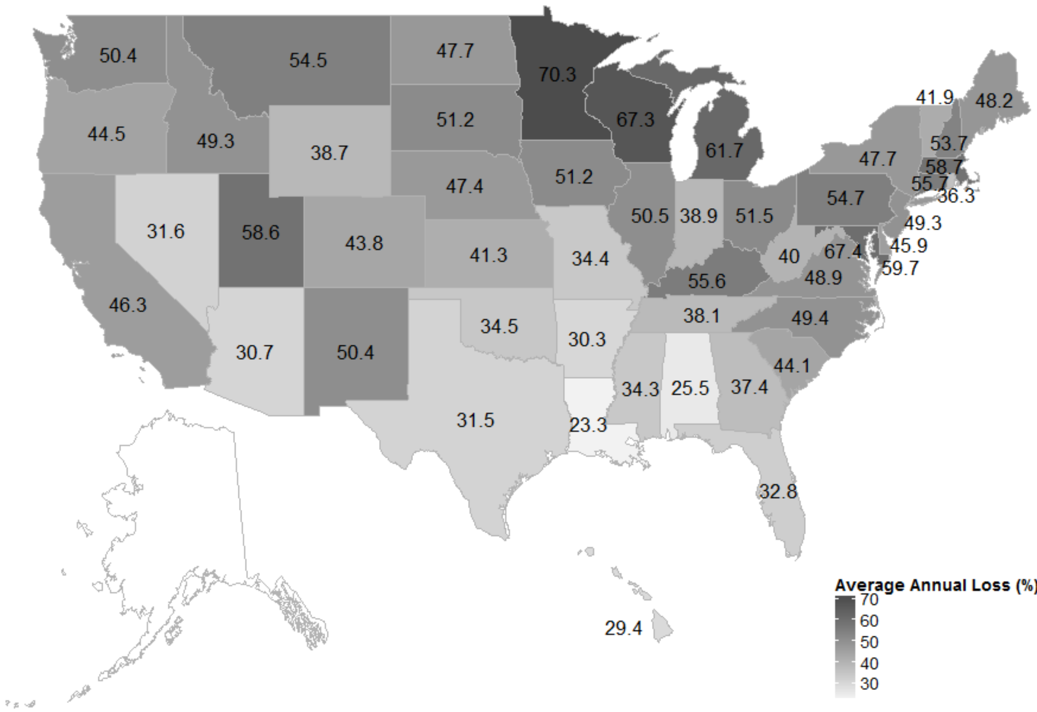


Figure 3. 7: Total annual loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which they

reported managing colonies. Data for states with fewer than five respondents are withheld.



<u>Figure 3. 8:</u> Average annual loss (%) by state. Respondents who managed colonies in more than one state had all of their colonies counted in each state in which they reported managing colonies. Data for states with fewer than five respondents are withheld.

Table 3 - 7: Estimates of total and average summer, winter and annual colony loss by US states, showing the number of operations (or number of valid respondents), number of colonies at the start of the period of interest, total colony loss (%), and average colony loss (%), by state of operation, for each season (summer, winter and annual). Each loss estimate (%) is presented along with its 95% CI. Data for states with fewer than five respondents are withheld. Total Loss was calculated by dividing the sum of colonies lost[a] by the sum of colonies at risk[b] of all participants combined. [a] Colonies Lost: the sum of colonies at risk minus the sum of the number of colonies managed on April 2013. [b] Colonies at risk: the sum of the total number of colonies managed on October 2012 and colonies bought or made between October 2012 and April 2013 subtracting the total number of colonies sold between October 2012 and April 2013. Average Loss was calculated as the mean of all individual winter loss (a mean of proportions).

	Summer Loss				Winter Loss									Annual Loss		
	n (# of operations)	**Total # of colonies (04/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**n Backyard BK**	**n Sideline BK**	**n Commercial BK**	**Median # of colonies (10/2012)**	**Mean # of colonies (10/2012)**	**Total # of colonies (10/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**
US	4,181	509,038	25.27 [24.8-25.75]	12.49 [11.91-13.06]	6,482	6,114	233	135	4	98.11	635,971	30.64 [30.16-31.13]	44.77 [43.88-45.67]	4,429	45.16 [44.58-45.75]	49.44 [48.46-50.43]
STATE:																
Alabama	36	422	16.89 [12.26-22.33]	12.67 [7.05-18.3]	50	45	4	1	5	53.34	2,667	15.76 [9.92-23.1]	19.16 [11.44-26.88]	36	55.08 [45.34-64.57]	25.54 [16.5-34.58]
Alaska	2	.	.	.	2	.	.	.	.	.	.	.	.	2	.	.
Arizona	9	1,770	10.07 [8.78-11.45]	11.12 [1.21-21.02]	13	12	0	1	3	159.15	2,069	12.6 [10.4-15.05]	18.13 [6.13-30.13]	9	21.45 [18.75-24.32]	30.68 [11.91-49.44]
Arkansas	37	1,312	17.35 [14.51-20.46]	14.91 [7.39-22.43]	56	53	1	2	3	35.50	1,988	13.93 [11.66-16.43]	22.53 [14.19-30.87]	38	28.13 [25.72-30.63]	30.25 [21.34-39.17]
California	216	404,981	27.1 [25.17-29.08]	17.03 [14.69-19.36]	291	163	36	92	18	1652.02	480,737	28.58 [26.67-30.54]	37.5 [33.92-41.08]	226	45.38 [43.01-47.75]	46.27 [42.66-49.89]
Colorado	167	819	12.22 [9.8-14.95]	10.52 [7.6-13.44]	314	310	4	0	2	5.39	1,694	47.27 [44.08-50.48]	40.12 [35.73-44.52]	178	50.46 [46.43-54.49]	43.77 [38.3-49.24]
Connecticut	57	517	13.1 [9.33-17.61]	17.15 [11.51-22.78]	78	75	3	0	3.5	12.94	1,009	52.43 [46.11-58.7]	49.29 [40.53-58.06]	58	57.69 [51.34-63.86]	55.72 [46.97-64.47]
District of Columbia	10	242	42.91 [30.72-55.71]	14.77 [1.06-28.48]	14	12	2	0	2	21.43	300	54.72 [43.91-65.24]	65.05 [49.27-80.84]	10	73.48 [68.37-78.2]	67.43 [48.47-86.39]
Delaware	23	11,817	48.43 [43.28-53.6]	13.53 [5.92-21.13]	33	29	2	2	4	303.33	10,010	17.07 [12.14-22.9]	40.07 [29.23-50.9]	25	48.15 [46.04-50.27]	45.87 [35.17-56.57]
Florida	103	46,986	29.46 [25.9-33.2]	18.23 [14.31-22.14]	136	107	14	15	6	365.46	49,702	24.66 [21.8-27.69]	22.42 [18.18-26.67]	107	41.55 [38.92-44.22]	32.77 [28.2-37.33]
Georgia	74	6,874	14.3 [12.01-16.81]	12.41 [8.34-16.47]	117	108	6	3	5	81.05	9,483	43.31 [38.86-47.84]	37.3 [31.21-43.4]	78	48.78 [44.15-53.41]	37.38 [30.09-44.67]
Hawaii	45	10,107	15.08 [8.8-23.24]	18.78 [10.94-26.63]	61	50	7	4	9	211.48	12,900	11 [7.28-15.65]	19.46 [12.38-26.55]	46	18.84 [13.81-24.67]	29.42 [21.13-37.71]
Idaho	31	64,792	24.08 [20.25-28.2]	20.11 [12.96-27.27]	41	24	5	12	23	1625.85	66,660	20.78 [16.5-25.54]	42.13 [32.69-51.57]	31	36.15 [31.44-41.06]	49.29 [41.18-57.4]
Illinois	132	3,694	4.04 [2.1-6.85]	9.64 [6.59-12.7]	202	199	2	1	4	26.14	5,281	27.91 [25.27-30.65]	47.93 [42.69-53.17]	136	29.16 [25.8-32.68]	50.53 [44.41-56.64]

	Summer Loss				Winter Loss									Annual Loss		
	n (# of operations)	**Total # of colonies (04/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**n Backyard BK**	**n Sideline BK**	**n Commercial BK**	**Median # of colonies (10/2012)**	**Mean # of colonies (10/2012)**	**Total # of colonies (10/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**
Indiana	108	2,625	6.03 [4.6-7.71]	9.74 [6.82-12.66]	173	166	6	1	5	23.29	4,030	24.5 [22.19-26.92]	36.37 [31.82-40.93]	115	26.88 [24.21-29.66]	38.87 [33.6-44.15]
Iowa	45	4,701	10.29 [6.18-15.69]	12.18 [7.24-17.13]	63	51	10	2	8	103.73	6,535	28.77 [23.99-33.89]	49.67 [41.92-57.42]	49	34.88 [28.93-41.17]	51.19 [43.29-59.08]
Kansas	39	1,382	19.97 [14.91-25.76]	13 [7.5-18.51]	51	44	6	1	6	45.67	2,329	30.31 [25.52-35.42]	29.39 [20.94-37.85]	40	40.9 [34.96-47.02]	41.3 [32.01-50.58]
Kentucky	46	421	18.35 [12.79-24.95]	10.28 [5.24-15.33]	67	63	4	0	5	11.18	749	33.25 [27.28-39.59]	52.37 [43.96-60.78]	49	43.42 [36.5-50.51]	55.62 [46.22-65.02]
Louisiana	14	490	38.83 [31.39-46.62]	13.27 [3.85-22.7]	22	20	1	1	9	102.91	2,264	18.36 [16.69-20.12]	11.81 [6.55-17.07]	14	21.78 [15.71-28.8]	23.25 [14.32-32.19]
Maine	103	45,213	29.01 [26.12-32.01]	12.07 [8.46-15.68]	177	169	3	5	3	270.34	47,851	21.08 [19.46-22.76]	42.59 [37.18-48.01]	108	39.85 [38.19-41.53]	48.22 [42.22-54.22]
Maryland	182	12,840	47.59 [45.53-49.66]	13.74 [10.74-16.75]	271	260	9	2	3	43.69	11,840	21.18 [18.78-23.72]	57.04 [52.7-61.38]	198	49.34 [48.08-50.59]	59.75 [55.03-64.46]
Massachusetts	151	14,518	19.75 [19.17-20.34]	13.29 [10.19-16.39]	245	241	2	2	2	73.04	17,896	21.91 [20.47-23.41]	53.85 [48.9-58.8]	160	33.83 [32.37-35.3]	58.7 [53.49-63.91]
Michigan	205	22,462	31.75 [28.58-35.04]	13.64 [10.94-16.34]	313	293	15	5	4	75.14	23,519	21.56 [19.21-24.03]	56.8 [52.77-60.82]	220	41.58 [39.33-43.86]	61.72 [57.27-66.17]
Minnesota	75	45,195	30.39 [26.43-34.56]	16.67 [11.92-21.43]	117	101	2	14	5	459.26	53,734	38.73 [35.17-42.38]	65.68 [59.97-71.39]	81	54.48 [51.27-57.68]	70.33 [64.68-75.99]
Mississippi	27	108,564	38.85 [36.35-41.39]	15.95 [9.03-22.86]	41	31	6	4	9	2187.93	89,705	37.57 [35.25-39.91]	29.41 [20.72-38.09]	31	60.03 [56.54-63.46]	34.27 [24.86-43.67]
Missouri	76	937	11.21 [8.24-14.72]	13.04 [8.87-17.21]	104	98	6	0	5	15.35	1,596	22.94 [18.98-27.24]	24.62 [19.31-29.93]	78	30.69 [25.77-35.94]	34.4 [28.27-40.53]
Montana	26	30,236	13.97 [9.7-19.12]	17.66 [10.05-25.27]	45	30	3	12	5	1178.09	53,014	20.39 [15.99-25.31]	45.9 [36.59-55.21]	27	30.01 [21.47-39.6]	54.51 [43.58-65.44]
Nebraska	14	85,765	39.22 [35-43.55]	16.73 [2.19-31.27]	23	19	1	3	8	3355.35	77,173	37.85 [34.21-41.59]	47.77 [34.86-60.68]	16	62.18 [56.26-67.85]	47.41 [32.37-62.45]
Nevada	4	.	.	.	11	7	2	2	4	610.91	6,720	32.24 [24.44-40.76]	27.52 [7.9-47.14]	6	33.27 [24.44-42.96]	31.57 [10.85-52.29]
New Hampshire	57	511	7.46 [4.85-10.78]	10.33 [5.76-14.9]	96	93	3	0	2	9.35	898	35.12 [29.36-41.18]	46.52 [38.15-54.89]	58	36.77 [29.7-44.25]	53.74 [43.9-63.58]

	Summer Loss				Winter Loss									Annual Loss		
	n (# of operations)	Total # of colonies (04/2012)	Total Loss mean [95% CI]	Average Loss mean [95% CI]	n (# of operations)	n Backyard BK	n Sideline BK	n Commercial BK	Median # of colonies (10/2012)	Mean # of colonies (10/2012)	Total # of colonies (10/2012)	Total Loss mean [95% CI]	Average Loss mean [95% CI]	n (# of operations)	Total Loss mean [95% CI]	Average Loss mean [95% CI]
New Jersey	61	24,259	34.93 [30.84-39.19]	15.81 [10.86-20.76]	87	84	1	2	4	284.44	24,746	17.07 [15.56-18.66]	43.13 [35.09-51.16]	65	39.91 [38.09-41.75]	49.32 [40.9-57.73]
New Mexico	9	42	6.41 [1.19-17.93]	11.48 [0.71-22.25]	27	27	0	0	3	4.74	128	33.15 [21.53-46.34]	35.35 [22.6-48.1]	9	60.56 [39.75-79.03]	50.37 [27.46-73.28]
New York	178	39,988	31.19 [28.72-33.72]	11.33 [8.83-13.83]	270	247	11	12	5	171.10	46,196	26.54 [23.98-29.21]	43.91 [39.85-47.98]	189	40.46 [38.45-42.5]	47.74 [43.41-52.07]
North Carolina	277	3,578	26.26 [23.45-29.21]	13.76 [11.34-16.18]	415	405	9	1	4	12.48	5,181	34.1 [31.45-36.81]	43.37 [39.87-46.87]	295	45.89 [43.42-48.38]	49.4 [45.58-53.22]
North Dakota	36	189,516	23.7 [19.78-27.96]	24.03 [18.78-29.28]	38	5	1	32	2894	5532.37	210,230	26.89 [22.02-32.15]	36.42 [28.15-44.69]	35	42.23 [36.62-47.97]	47.65 [39.98-55.33]
Ohio	182	11,444	48.93 [46.88-50.98]	11.16 [8.57-13.75]	281	273	6	2	4	42.67	11,989	18.56 [16.53-20.72]	48.69 [44.58-52.8]	200	46.53 [45.41-47.65]	51.5 [47.02-55.97]
Oklahoma	29	3,632	59.79 [55.16-64.31]	20.22 [11.5-28.94]	37	34	2	1	5	91.59	3,389	14.1 [11.46-17.04]	18.85 [10.62-27.09]	29	65.41 [61.21-69.45]	34.54 [25.78-43.31]
Oregon	123	22,059	18.56 [17.02-20.17]	8.94 [6.13-11.75]	194	178	10	6	3	195.56	37,938	26.54 [24.31-28.85]	38.14 [33.1-43.18]	125	36.35 [34.2-38.54]	44.45 [38.51-50.4]
Pennsylvania	351	22,097	34.22 [32.15-36.33]	9.82 [8.14-11.5]	565	538	22	5	4	45.03	25,443	27.94 [25.91-30.03]	51.99 [48.91-55.07]	376	45.91 [44.43-47.4]	54.73 [51.34-58.13]
Puerto Rico	0	.	.	.	1	.	.	.	.	.	.	.	.	0	.	.
Rhode island	15	62	5.06 [0.5-17.67]	8.93 [-1.49-19.35]	28	28	0	0	3	7.32	205	34.7 [27.03-42.95]	36.66 [23.64-49.67]	15	37.5 [27.69-48.06]	36.26 [21.51-51.02]
South Carolina	67	4,059	13.51 [11.93-15.21]	11.06 [7.23-14.89]	96	93	2	1	4	42.57	4,087	15.53 [11.65-20.03]	40.79 [34.34-47.23]	72	21.5 [17.57-25.82]	44.08 [37.03-51.13]
South Dakota	6	85,132	39.96 [35.38-44.66]	17.49 [4.56-30.41]	8	4	0	4	1026	9723.75	77,790	39.03 [35.52-42.61]	46.58 [24.72-68.43]	6	63.32 [57.31-69.06]	51.19 [29.28-73.11]
Tennessee	56	626	16.03 [13.1-19.28]	8.07 [4.4-11.74]	94	88	6	0	5.5	13.62	1,280	43.06 [37.29-48.96]	35.77 [29.34-42.2]	61	51.57 [44.82-58.29]	38.09 [30.5-45.68]
Texas	56	66,951	24.56 [22.39-26.83]	12.88 [8.51-17.26]	77	58	4	15	7	1039.14	80,014	36.53 [32.87-40.3]	26.71 [20.81-32.61]	56	49.17 [45.17-53.17]	31.49 [24.31-38.67]
Utah	46	9,736	17.5 [15.49-19.65]	16.08 [10.24-21.93]	80	70	6	4	5	161.21	12,897	40.83 [34.64-47.22]	52.5 [45.01-60]	50	50.25 [43.62-56.88]	58.64 [50.96-66.33]

	Summer Loss				Winter Loss									Annual Loss		
	n (# of operations)	**Total # of colonies (04/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**n Backyard BK**	**n Sideline BK**	**n Commercial BK**	**Median # of colonies (10/2012)**	**Mean # of colonies (10/2012)**	**Total # of colonies (10/2012)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**	**n (# of operations)**	**Total Loss mean [95% CI]**	**Average Loss mean [95% CI]**
Vermont	39	2,854	8.53 [6.38-11.06]	10.74 [4.71-16.77]	76	67	6	3	4	54.63	4,152	27.09 [23.29-31.14]	40.62 [32.72-48.52]	45	29.67 [26.35-33.14]	41.9 [32.81-50.99]
Virginia	470	14,497	42.94 [41.29-44.6]	12.82 [11.04-14.6]	698	684	12	2	3	21.13	14,750	22.91 [21.26-24.62]	44.26 [41.57-46.95]	493	47.62 [46.49-48.76]	48.85 [45.86-51.84]
Washington	110	49,972	28.52 [26.84-30.23]	14.14 [10.18-18.09]	178	164	6	8	4	390.97	69,593	22.71 [21.33-24.12]	45.32 [39.83-50.8]	116	43.06 [41.19-44.94]	50.44 [44.07-56.82]
West Virginia	60	2,124	14.12 [12.57-15.77]	8.65 [5.3-12]	86	83	2	1	6	29.79	2,562	45.41 [40.99-49.88]	38.07 [30.82-45.32]	64	54.85 [50.19-59.45]	40.02 [32.17-47.88]
Wisconsin	131	19,153	35.33 [31.46-39.32]	16.55 [12.71-20.39]	184	165	12	7	5	113.34	20,854	23.31 [20.26-26.55]	62.76 [57.79-67.74]	138	44.42 [41.89-46.98]	67.29 [62.49-72.09]
Wyoming	13	13,370	15.58 [11.17-20.8]	10.89 [3.47-18.31]	21	13	3	5	15	778.81	16,355	37.52 [26.96-48.94]	33.53 [18.27-48.8]	13	46.37 [32.13-61.02]	38.65 [22.86-54.44]

Discussion

This survey reports the seventh year of consecutive estimates of overwintering colony losses for the US and for the first time reports summer and annual losses.

With the exception of the winter of 2011-2012 (TWL = 22.5%; Spleen et al., 2013), US total overwintering loss estimates have fluctuated around 30% (31.8%, 35.8%, 28.6%, 34.4%, and 29.9% for the winters of 2006-7, 2007-8, 2008-9, 2009-10 and 2010-11, respectively; vanEngelsdorp et al., 2012, 2011, 2010, 2008, 2007). Our estimate for the winter 2012-2013 at 30.6% (TWL) conforms to the current pattern of high overwintering colony losses.

Several of our results point out that the 2012-2013 winter has been particularly challenging for beekeepers to keep their colonies alive. Since winter losses have been quantified by surveys, average winter loss has mostly been higher than total winter loss (with total *vs.* averages of 31.8% vs 37.6%, 35.8% vs 31.3%, 28.6% vs 34.2%, 34.4% vs 42.2%, 29.9% vs 38.4%, 22.5% vs 25.4% for the winters of 2006-7, 2007-8, 2008-9, 2009-10, 2010-11 and 2011-12, respectively; Spleen et al., 2013; vanEngelsdorp et al., 2007, 2008, 2010, 2011, 2012), and it is yet again the case with the estimates in the current study. However, this survey year's average winter loss was higher than in previous years at 44.8%. This means that during this winter 2012-2013, while the US region as a whole lost 30.6% of its colonies, each beekeeper lost on average 44.8% of his/her colonies. Moreover, during the winter of 2012-13, only 24% of respondents reported zero colony losses, while over the previous two winters, 45% and 33% of respondents, respectively, made this claim (Spleen et al., 2013; vanEngelsdorp et al., 2012). Finally, 52.3% of respondents to this survey claimed that their overwintering losses were higher in 2013 compared to the previous year. A higher average loss per beekeeper, fewer individual beekeepers reporting no loss and more than one in two beekeepers reporting worse losses compared to the previous year, all indicate a particularly difficult 2012-2013 wintering season.

Even though our survey size represents 25.5% of the colonies managed in the US as compared to USDA-NASS population estimate mentioned earlier, there is no census of the US beekeepers available, which prevents us from quantifying and adjusting for potential bias in our respondent pool. Despite our efforts to multiply the channels of solicitations, most of our approaches still rely on the internet, which might bias participation towards internet-savvy beekeepers. Knowing that previous results had repeatedly under-represented commercial beekeepers, strong efforts have been deployed this year to seek to increase their participation, with success, as their representation in the analytic sample for winter loss rose from 1.22% (n=67 of 5,500 respondents in 2012; Spleen et al., 2013) to 2.08% (n=135 of 6,482 respondents in this survey). Overall, the number of colonies represented in our survey (on 1 October) increased by 78.9% compared to the previous year's survey (635,971 colonies compared to 355,532 colonies; Spleen et al., 2013), perhaps indicating that the outreach efforts were productive.

This survey was not designed to identify causes of winter colony losses but instead to document trends in reported levels of loss and self-reported causes of death as identified by the beekeeper themselves. Difference in results from past surveys may result from changes in the respondent pool, which are difficult to correct without a comprehensive census of US beekeepers.

Commercial beekeepers lost, on average, a significantly lower percentage of colonies than sideline beekeepers and backyard beekeepers over the winter. They were also more likely to report the symptom “no dead bees in the hive or apiary” when experiencing winter loss, a symptom which is one of the defining characteristics of CCD (Cox-Foster et al., 2007; vanEngelsdorp et al., 2009).

This study’s estimate of the proportion of colonies that died with the symptom “no dead bees in the hive or apiary” is more than double compared to past years (51.3% of the colonies lost this winter 2012-2013 compared to 20.5% in 2012 and 26.3% in 2011; Spleen et al., 2013 and vanEngelsdorp et al., 2012). This was also reflected in the frequency of selecting “CCD” as a main cause of colony loss over the winter: 10.83% of the respondents who suffered a certain amount of loss identified CCD as main cause of overwintering loss in this survey. Only 8.6% (n=247 on 2,887 respondents) and 5.9% (n=199 on 3,389 respondents) did the same last year (Spleen et al., 2013; vanEngelsdorp et al., 2012). Beekeepers who reported they lost at least part of their colonies to the symptom “no dead bees in the hive or apiary” experienced greater loss on average than those not reporting this condition. Similarly, beekeepers who selected “CCD” as a self-reported cause of overwintering colony loss also experienced greater losses compared to beekeepers who did not select this factor. Only commercial beekeepers listed “CCD” as one of their most frequently reported factors of overwintering colony loss. Typically, as was the case in previous years (vanEngelsdorp et al., 2011b), we see that commercial beekeepers self-identified mostly non-manageable conditions (queen failure, pesticides or CCD) as leading causes of overwintering loss, while backyard beekeepers were more likely to report manageable conditions (starvation, colony weak in the fall).

Ideally we would compare our survey results with loss data from in field longitudinal studies. Unfortunately, few in field studies are available. A total loss of 56% was reported in a cohort of migratory honey bee colonies monitored for 10 months, which is higher than the estimate in this study (vanEngelsdorp et al., 2013b). The same study also identified “queen event” as one of the major risk factor of short-term colony mortality (vanEngelsdorp et al., 2013b), which supports our participating beekeepers’ judgment of identifying this factor as one of the leading cause of colony mortality. A field study in Ontario Canada identified fall *Varroa* mite levels, small fall bee populations, and low food reserves as leading causes of colony mortality (Guzmán-Novoa et al., 2010). Our ranking of the top-4 leading self-reported cause of death (colony weak in the fall, starvation, queen failure and *Varroa* mites) appears well supported by those two in the field studies, however, more in field verification of losses and causes of losses should be done to test the accuracy of our survey results.

Overall, more than 70% of the beekeepers experienced overwintering loss above the level US beekeepers consider acceptable in this winter 2012-2013, which might reflect the unusually high level of average winter loss, though there was considerable variation across states. In addition to a high overwintering loss, beekeepers also lost colonies during the summer period. On average, US beekeepers lost 12.5% of their colonies last summer and 49.4% over the entire course of the year. Commercial beekeepers lost significantly fewer colonies than backyard beekeepers in the winter but the situation is reversed in the summer where they experience a higher average loss than backyard beekeepers (30.2% (95% CI: 26.54 – 33.93 %) vs 45.4 % (44.46 – 46.32 %) respectively). This also explains the inversion between total and average loss for the summer estimates where total loss, strongly influenced by larger apiaries, is higher than average loss. This, together with the contrasted results concerning CCD symptoms and other self-reported causes of death, strongly suggests that beekeepers from different operation types are facing divergent challenges and encourages us to consider operation type as an important factor in understanding the causes of colony mortality.

We selected 1 October to 1 April to estimate overwintering colony loss because this period is thought to encompass the traditional inactive season of the colony and enables the beekeeper to make a first spring visit to estimate the mortality in his/her operation. However, the length of the inactive season varies according to the region and some important pollination activities occur during that period. While somewhat subjective, this constant reference period throughout studies enables for comparison of rates across time and regions. Overwintering has always been seen as the period of the year with the highest mortality risk, but with a total loss of 25.3% (95% CI: 24.8 – 25.75%) and an average loss per beekeeper of 12.5 % (95% CI: 11.91 – 13.06 %), the mortality over summer is far from negligible. Those results suggest that to capture a more complete picture of honey bee colony mortality and understand its drivers, survey studies documenting colony losses should report annual losses rather than winter losses only.

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Chapter 4: Ten years of national surveys of managed honey bee colony losses in the USA

Abtract

In the eleven years since this survey began, managed honey bee colony losses have become a great concern in the USA and over the world. In this report, we present revised State and operation type-specific estimates of the 10 preceding years of the Loss Survey as well as adjusted National estimates accounting for variation in representation of the beekeeping population.

This last year only, 4,983 valid survey respondents, who collectively managed 371,626 colonies on October 1st, 2016, 13% of the estimated total managed colonies in the USA. Responding beekeepers reported a total annual colony loss of 33.22 % [95% CI 32.57 - 33.88] between April 1st 2016 and April 1st 2017. Total winter colony loss was 21.12 % [95% CI 20.6 - 21.64] and total summer colony loss was 18.17 % [95% CI 17.65 - 18.69]. This is the lowest national level of Winter Loss on record. But there is extensive variation in risk from operation to operation. Over 60% (n=4,803) of responding beekeepers had higher losses than they deemed acceptable.

Introduction

In the fall of 2006, reports of sudden and widespread collapses of honey bee (*Apis mellifera* L.) colonies started flowing from across the United States. This prompted the creation of a partnership of researchers to investigate the condition later described as Colony Collapse Disorder (CCD), and initiated the first monitoring of colony losses in the United States (vanEngelsdorp et al., 2007). The 2016-2017 Loss Survey marks the 11 year anniversary of this monitoring effort, the most extended survey focusing on honey bee colony survivorship worldwide.

What started as a reporting system for CCD quickly evolved into the monitoring of a larger issue: a recurring high level of overwinter colony mortality stemming from multiple causes. Every year, participating beekeepers reported loss in excess to self-defined acceptable levels (Kulhanek et al., 2017; K. V. Lee et al., 2015; Seitz et al., 2015; Spleen et al., 2013; Steinhauer et al., 2014; vanEngelsdorp et al., 2007, 2008, 2010, 2011b, 2012). In 2011, the survey started recording information on colony deaths experienced over the summer and throughout the whole year to complement the estimates of overwintering losses. Since then, relatively high rates of colony losses have been reported in other places around the world (South America (Antúnez et al., 2017), Europe (van der Zee et al., 2014), South Africa (Pirk et al., 2014), which contrast with low levels of loss observed in China (Liu et al., 2016)). A common finding among all those studies is the large variability between subpopulations' estimates (individual countries or states). In the absence of hard data to estimate historic levels of loss, long term monitoring offers insights into the fluctuations of mortality rates in time and space.

As the primary pollinator in agricultural settings (Klein et al., 2007), managed honey bee colonies are a highly value commodity for which demand is only growing (Aizen and Harder, 2009). Although the global population of honey bees has been steadily increasing since the 1960', trends are uneven among countries. In the USA, during the same period, the number of honey bee colonies has decreased (Potts et al., 2010b, 2016), though the estimates seem to have stabilized over the past 20 years (~2.6

million colonies, (USDA NASS, 2017a)). Those population size estimates are largely driven by socio-economic drivers, such as the price of honey or the number of beekeepers (Moritz and Erler, 2016; Potts et al., 2010b; vanEngelsdorp and Meixner, 2010). The demands for pollination itself has impacted the price of pollination units (Lee et al., 2017), which can influence the ability of beekeepers to restore or increase their colony numbers. In this context, recurring high levels of loss endanger the sustainability of beekeeping operations and their ability to provide a constant and predictable supply of pollinator units for commercial pollination.

The causes of colony mortality are various, complex and interacting (Maggi et al., 2016; Pirk et al., 2016; vanEngelsdorp and Meixner, 2010), including pests and diseases, forage availability and pesticide exposure. Each of those stressors can impact honey bee health directly but also reducing their tolerance to other stressors, thereby aggravating their impact when acting simultaneously (Potts et al., 2010a).

The objectives of the national honey bee colony loss surveys are to 1) estimate the rate of colony loss of managed honey bee colonies in the USA, over the winter but also throughout the active season; 2) quantify the variation in the risk between specific types of stakeholders, based on characteristics of their operation. In this anniversary report, we are providing revised estimates of the preceding years of survey together with adjusted estimates to allow for meaningful comparison of year to year results and identification of trends over time.

<u>Materiel and methods</u>

Data acquisition

The Bee Informed Partnership (BIP) performed its first survey of US managed colony loss in the spring 2007. Since then, the survey has been implemented every year, though with some variations in methods, in particular in the first couple of years of the survey.

The surveys are of retrospective cross-sectional design with sampling scheme of convenience, meaning respondents volunteered information on their recollection of the status of their operation in the past year (April 1 to April 1) by way of a questionnaire (administered either over the phone, online or on paper). The sampling scheme was non-random in that the respondents constitutes a subset of the target population – US beekeepers, *i.e.* the managed honey bee population in the US – that were successfully contacted (by direct invitation, advertisement or word of mouth) and were willing to participate. It should be noted that no census of US beekeepers is currently available, making random-sampling scheme out of options. Active and intensive recruitment was deployed to try and limit potential selection bias, with particular emphasis towards large-scale operations. Details of the recruitment procedure and practical implementations can be found in all individual year reports previously published.

The Loss Survey was designed to record information at operation level, with one operation corresponding to all colonies managed by the same beekeeper (or lead beekeeper), in one or multiple apiaries. The demographic questions covered two 6-months periods every year ("Summer", from April 1 to October 1, and "Winter" from

October 1 to April 1). Other information, such as the believed leading cause of overwintering colony loss, or the participation to almond pollination, were recorded in a semi-structured way, combining single choice, multiple choices, and open-ended questions. Slight variations on the questions were made from year to year, particularly in the first couple of years of the survey. In particular, multiple choice options were modified to include frequently appearing themes from previous iterations of the survey.

Because of poor data archiving, the very first occurrence of the survey (2006-07) could not be integrated in this revised analysis. It should also be noted that the survey years 2007-08 and 2008-09 particularly differed from the subsequent years as they were mostly performed through phone interviews. The survey switched to email solicitation linking to an online survey from survey year 2009-10. Summer demographics and more intensive management questions were added as a separate and voluntary follow-up survey starting in survey year 2010-11. The summer demographic questions were moved from the follow-up to the main questionnaire in survey year 2013-14, from which point the Loss Survey was no longer modified.

Data validation

For each year of the survey, obvious duplicate answers were manually identified, based on the similarity of answers between sets identified with the same IP address or email address. A minimum of one selected state (from the mandatory multiple choice question: "*In what state(s) did you keep your colonies in between April 1, YY and April 1, YY?*") was required to qualify the entry as US based. The analytical dataset was composed of the remaining unique US sets of responses which also provided sufficient demographic data for the calculation of summer and/or winter operational loss. In particular, the answers should allow the calculation of a valid loss rate (between 0 to 100% with a non-zero number of colonies at the start of the season). Annual loss was calculated exclusively for operations which provided valid responses for both summer and annual loss for that year (making the sample size for annual loss smaller than either summer and winter loss sample sizes). Obvious typing errors in the report of colony numbers (*e.g.*, non-integer number or exceedingly large (>80,000)) were filtered out of the analytical dataset (following Steinhauer et al., 2014). Where appropriate, some responses were edited for processing (*e.g.*, replacement of text with numbers – “2” instead of “two”) in copies of the database (with the original raw answers kept in a separate database for archive). As some of the non-demographic questions were not mandatory, the response rate of those questions might vary from the sample size of the analytical dataset.

For past survey years, all steps of the validation (with the exception of the identification of duplicate entries) and analyses were performed anew using the rawest datasets available, so that each step of the validation and data processing was recorded through script. All data handling and analyses were performed using R (R versions 3.2.2 (2015-08-14) and 3.4.0 (2017-04-21)- Platform: x86_64-w64-mingw32/x64 (64-bit)) (R Core Team, 2017).

Data analyses

Representativity of BIP samples

1. Total respondents and population estimates

The target of this series of surveys is the population of managed honey bee colonies in the US. Unfortunately, there is currently no available census of beekeepers and the number of colonies they manage in the US. Several surveys conducted by the National Agricultural Statistics Service (NASS) can be used as a rough baseline, bearing some assumptions (Appendix 1). We present our results in comparison to each of those sets of estimates. Over all NASS surveys, the most notable difference between BIP and NASS is that NASS surveys target operations that also qualify as farms, which excludes most of the small-scale beekeepers.

The “Honey Report” (USDA NASS, 2017a) is the longest standing survey and focusing on honey production. It provides yearly estimates of the total number of colonies from which honey was harvested – colonies were not included if honey was not harvested – for operations of 5 or more colonies that also qualify as a farm. However, colonies which produced honey in more than one state are counted in each of the states where honey was produced, resulting in some colonies counted multiple times in the national total. In addition, the Honey Report do not provide estimates of number of operations.

The census of agriculture was conducted three times during our period of interest: 2007 (USDA NASS, 2009), 2012 (USDA NASS, 2014a) and 2017 (not published). Again, its target population is limited to operations qualifying as farms. In their own words: “*Colonies of bees were tabulated in the county where the bees’ owner had the* *largest value of all agricultural products raised or produced. Colonies are often moved from farm-to-farm over a wide geographic area. Package bees are not included as separate colonies. Colonies of bees were collected in their own section to clarify to respondents that only "owned" colonies were to be reported versus any colonies on the operation. Published colonies inventory is the total number of colonies owned on December 31, 2012*" (USDA NASS, 2014a). As a special request, USDA NASS produced a tabulation of the 2012 numbers of farms and colonies grouped in 3 categories of operation size [1-50 colonies], [51-500] and [501+[. That data was unfortunately not available for the 2007 census.

Finally, the "Honey Bee Colonies" report is the most recent survey organized by NASS. The first installment of the survey was conducted from January 2015 to March 2016 (USDA NASS, 2016). The second report covers January 2016 to June 2017 (USDA NASS, 2017b). This survey gathers quarterly estimates of the number of colonies for operations that qualify as farms. This report provides states estimates of the number of colonies present in each state at the beginning of the quarter for operations of 5 or more colonies, as well as national estimates for operations of less than 5 colonies.

We estimated the global coverage of our survey compared to the various estimates of total population size (both number of operations and number of colonies) over the years. When the national estimate was not available for a certain year, we extrapolated it using the average of the closest value published (see original and extrapolated numbers in Table 4 - 1).

2. Distribution by State

We used NASS State estimates to check (and account) for variation in the representation of various states in our sample population. First we calculated the relative apportionment of farms and colonies associated with one state compared to the national population estimate using NASS Honey Report and NASS Census (with extrapolation with years in between censuses). We then compared this distribution to the apportionment of operations and colonies across states from BIP surveys. The residuals informed us of the magnitude and directionality of the misrepresentation. As BIP survey is originated and organized mostly from the East Coast, we expected to find evidence of overrepresentation of east coast beekeepers. Given the extent of effort to contact large-scale beekeepers, we did not expect to see such effect in the number of colonies. However, because colonies from multi-state operations are allocated in each of the states visited over the course of the year, states heavily associated with migratory beekeeping might appear over-represented in our sample. This is due to the fact that we miss an objective reasoning to assign migratory colonies to one specific state. Those colonies, however, are not double counted in the national counts.

3. Population structure by operation size

At our request, NASS provided a tally of the number of farms and colonies grouped by operation size based on information published in the 2012 Census of Agriculture report. Because the Census targets operations of over 5 colonies qualifying as farm, we expect the proportion of backyard beekeepers to appear over-represented in our survey in comparison.

Operational Loss estimates

Operational loss for each season (“Summer”, from April 1 to October 1, and “Winter” from October 1 to April 1, and “Annual”, from April 1 to next April 1) are rates calculated for every respondent based on the demographic answers provided for their operation. It corresponds to the number of colonies lost during a specific period divided by the number of colonies at risk (Steinhauer et al., 2014). In contrast to NASS surveys, the number of colonies lost is not directly provided by the respondents, but calculated based on the difference between the expected number of colonies at the end of the period and the actual number of colonies reported.

We also report the average level of self-reported “acceptable” level of overwintering loss and the proportion of operations reporting losses in excess to their self-determined threshold. Linear trends in the change in proportion of operations reporting no loss over a specific season, and operations reporting acceptable levels of loss, were analyzed using a Chi^2 test for trend in proportions (prop.trend.test, library(stats), R).

Sub-populations Loss estimates

Population estimates of loss for each grouping of interest (by state, operation type or other typology) were calculated following the standard outlined by (vanEngelsdorp et al., 2013a), by aggregating operational losses in 2 different ways. The weighted average of operational losses resulted in the “Total Loss”, in which each the total number of colonies lost over the whole population is divided by the total number of colonies at risk. The unweighted average of operational losses resulted in the

“Average Loss”, in which each operation was given the same weight, irrelevant of the number of colonies they represented. Confidence intervals (95% CI) around population estimates were calculated following vanEngelsdorp (et al., 2013).

The groupings explored in this analysis corresponded to 1) the operation type, as categorized by operation size on October 1st (with the levels [1-50] or “backyard”, [51-500] or “sideline”, and [501,+[or “commercial” operations); 2) the states were colonies were present over the course of the year.

Comparison of the risk between categories were performed using a logistic mixed effect model (glmer, library(lme4)) using survey year as a random effect. Different fixed effect structures were compared using the Maximum Likelihood method (ML). After significance of a main effect was confirmed, levels were contrasted using multiple comparisons (Tukey contrasts) with Bonferroni correction (glht, library(multcomp)). Mean predicted values are produced for judging impact size and directionality.

To account for the influence of multi-state operations, which are represented in each of the States in which the operation was associated over the course of the year, the State summaries provide estimates for 1) the total number of colonies present in the state at any time of the year (“All operations in the State”), 2) colonies associated exclusively to the State (“Exclusive to the State”), and 3) colonies from multi-state operations that were associated with the State at any time of the year (“Multi-state operations”). Finally, we visualized the variations of States over the years as their residuals when compared to the national average for each year.

National adjusted Loss estimates

The US national estimates of "Total" and "Average" colony loss for each of the 3 seasons were calculated in the same manner as for all other groupings of beekeepers. In addition, the Total Loss crude estimate was adjusted to account for a potential misrepresentation in the relative proportion of respondents. We performed two methods of adjustment. In the first one, we recalibrated our respondents' pool to the best available estimate of the distribution of colonies across the US, provided by the estimated number of colonies from NASS Census of Ag Report. The NASS Census of Ag report provided the most complete list of States (only missing DC and PR), compared to the Honey Report (which pooled numbers from AK, CT, DE, DC, MD, MA, NE, NH, NM, OK, PR, RI and SC) or the Honey Bee Report (which combined estimates from AK, DE, DC, NE, NH, PR and RI). Our Total Loss estimates calculated by season, year and States were re-allocated to the target population to produce so much estimates of the total number of colonies expected to be lost, which could be summed at the national level. In a second method of adjustment of the national estimates, we applied the same technique as above using our State estimated based only on single-state beekeepers. Multi-state beekeepers were accounted for at a constant proportion in each year. We used the 10 year average proportion of multi-state to single-states colonies for this statistic. The first method of adjustment accounts for variation in the response rate across states and over the years. The second method allows us to account for variation in the representation of single-state vs multi-states operations, which are more likely to be large-scale. These 2 methods of adjustments were compared to provide an estimate of the incertitude of the national estimates of Total Loss.

Results

Sample sizes and Representativity of BIP samples

All respondents

Over the 10 years of survey, 56,848 individual entries were recorded, from which 55,478 were identified as unique sets of responses, and 51,318 were associated with a US location. Of those unique US sets of responses, 47,814 provided valid demographic data and composed our analytical dataset. A total of 46,841 sets provided validated answer for the calculation of operational winter loss. The more recent addition of summer and annual demographic questions resulted in a total of 29,908 validated response sets for the calculation of operational summer loss and 28,898 sets for operational annual loss.

Table 4 - 1: Survey sample sizes compared to NASS estimates of number of colonies and farms

				NASS Census				NASS Honey		NASS Bee Colonies	
Survey Year	Subset	Operations	Colonies	Farms	Colonies	% Farms	% Col.	H.p. Col.	% H.p.Col.	Col. (quarter)	% Col. (quarter)
All Years	WL	46,841	4,420,549	*351,551*	*31,686,186*	*13.32*	*13.95*	*25,820,000*	*17.12*	*28,904,900*	*15.29*
2007-08	WL	506	477,298	**27,908**	**2,902,732**	**1.81**	**16.44**	**2,443,000**	**19.54**	*2,874,760*	*16.60*
2008-09	WL	777	461,980	*30,496*	*2,997,692*	*2.55*	*15.41*	**2,342,000**	**19.73**	*2,874,760*	*16.07*
2009-10	WL	4,212	436,354	*33,085*	*3,092,651*	*12.73*	*14.11*	**2,498,000**	**17.47**	*2,874,760*	*15.18*
2010-11	WL	5,556	326,763	*33,085*	*3,092,651*	*16.79*	*10.57*	**2,692,000**	**12.14**	*2,874,760*	*11.37*
2011-12	WL	5,466	353,359	*35,673*	*3,187,611*	*15.32*	*11.09*	**2,491,000**	**14.19**	*2,874,760*	*12.29*
2012-13	WL	6,486	646,008	**38,261**	**3,282,570**	**16.95**	**19.68**	**2,539,000**	**25.44**	*2,874,760*	*22.47*
2013-14	WL	7,193	505,242	*38,261*	*3,282,570*	*18.80*	*15.39*	**2,640,000**	**19.14**	*2,874,760*	*17.58*
2014-15	WL	5,937	414,267	*38,261*	*3,282,570*	*15.52*	*12.62*	**2,740,000**	**15.12**	*2,874,760*	*14.41*
2015-16	WL	5,725	427,652	*38,261*	*3,282,570*	*14.96*	*13.03*	**2,660,000**	**16.08**	**2,874,760**	**14.88**
2016-17	WL	4,983	371,626	*38,261*	*3,282,570*	*13.02*	*11.32*	**2,775,000**	**13.39**	**3,032,060**	**12.26**
All Years	SL	29,908	2,278,348	*260,062*	*22,693,112*	*11.50*	*10.04*	*18,537,000*	*12.29*	*19,898,470*	*11.45*
2010-11	SL	2,398	118,957	*33,085*	*3,092,651*	*7.25*	*3.85*	**2,692,000**	**4.42**	*2,849,500*	*4.17*
2011-12	SL	3,286	176,635	*35,673*	*3,187,611*	*9.21*	*5.54*	**2,491,000**	**7.09**	*2,849,500*	*6.20*
2012-13	SL	4,177	508,985	**38,261**	**3,282,570**	**10.92**	**15.51**	**2,539,000**	**20.05**	*2,849,500*	*17.86*
2013-14	SL	5,963	397,773	*38,261*	*3,282,570*	*15.59*	*12.12*	**2,640,000**	**15.07**	*2,849,500*	*13.96*
2014-15	SL	4,971	370,063	*38,261*	*3,282,570*	*12.99*	*11.27*	**2,740,000**	**13.51**	*2,849,500*	*12.99*
2015-16	SL	4,875	399,055	*38,261*	*3,282,570*	*12.74*	*12.16*	**2,660,000**	**15.00**	**2,849,500**	**14.00**
2016-17	SL	4,238	306,880	*38,261*	*3,282,570*	*11.08*	*9.35*	**2,775,000**	**11.06**	**2,801,470**	**10.95**
All Years	AL	28,898	2,170,684	*260,062*	*22,693,112*	*11.11*	*9.57*	*18,537,000*	*11.71*	*19,898,470*	*10.91*
2010-11	AL	2,361	108,944	*33,085*	*3,092,651*	*7.14*	*3.52*	**2,692,000**	**4.05**	*2,849,500*	*3.82*
2011-12	AL	3,256	172,964	*35,673*	*3,187,611*	*9.13*	*5.43*	**2,491,000**	**6.94**	*2,849,500*	*6.07*
2012-13	AL	4,130	493,739	**38,261**	**3,282,570**	10.79	15.04	**2,539,000**	**19.45**	*2,849,500*	*17.33*
2013-14	AL	5,733	382,883	*38,261*	*3,282,570*	*14.98*	*11.66*	**2,640,000**	**14.50**	*2,849,500*	*13.44*
2014-15	AL	4,775	337,633	*38,261*	*3,282,570*	*12.48*	*10.29*	**2,740,000**	**12.32**	*2,849,500*	*11.85*
2015-16	AL	4,624	373,710	*38,261*	*3,282,570*	*12.09*	*11.38*	**2,660,000**	**14.05**	**2,849,500**	**13.11**
2016-17	AL	4,019	300,811	*38,261*	*3,282,570*	*10.50*	*9.16*	**2,775,000**	**10.84**	**2,801,470**	**10.74**

Legend: Season: WL, Winter Loss subset, SL, Summer Loss subset, AL, Annual Loss subset; Operations: number of unique respondent or operations; Colonies: number of colonies at the start of the season (October 1st for WL, April 1st for SL and AL); National Agricultural Statistics Service (NASS) published estimates of honey bee colonies for the United States during the years overlapping with the present study: NASS Census (Census of Agriculture 2007 and 2012): number of farms and number of colonies; % Farms and colonies: comparison between the present study's number of operations and colonies to the NASS estimates; NASS Honey (Honey Reports, 2007 to 2016): H.p.Col = honey producing colonies; %H.p.Col = comparison between the present study's number of colonies to the NASS estimate; NASS Bee Colonies (Bee Colonies Reports 2016 and 2017): Col. (quarter): number of colonies at the start of the relevant quarter (Oct-Dec for WL, Apr-Jun for SL and AL); % Col. (quarter) = comparison between the present study's number of colonies to the NASS estimates. Estimates published by NASS are presented in bold, while extrapolations based on average of closest values are presented in red and italic. All comparisons based on published NASS estimates are shown in bold while comparisons based on extrapolated data are shown in red and italic.

The Winter Loss estimates were based on between 506 and 7,193 operations per year, with a median of about 5,500 operations per year. Together, they managed between ~327,000 and 646,000 colonies on October 1st, with a median of ~432,000 colonies per year. In comparison to the estimates of total number of farms and colonies in the US issued by NASS Census of Agriculture (extrapolated for years in between censuses), our respondents represented about 13% of the national operations, and about 14% of the national number of colonies (Table 4 - 1). This representation varied across the years of BIP survey, with lowest numbers of operations represented in the first two iterations of the survey, before online platforms were used. We note however, that the number of colonies represented in this survey was still on par with the subsequent years. If NASS Honey producing colonies is used, the number of colonies represented over the years is over 17%. NASS Honey Report do not provide estimates of the number of operations in the US. The comparison to NASS Bee

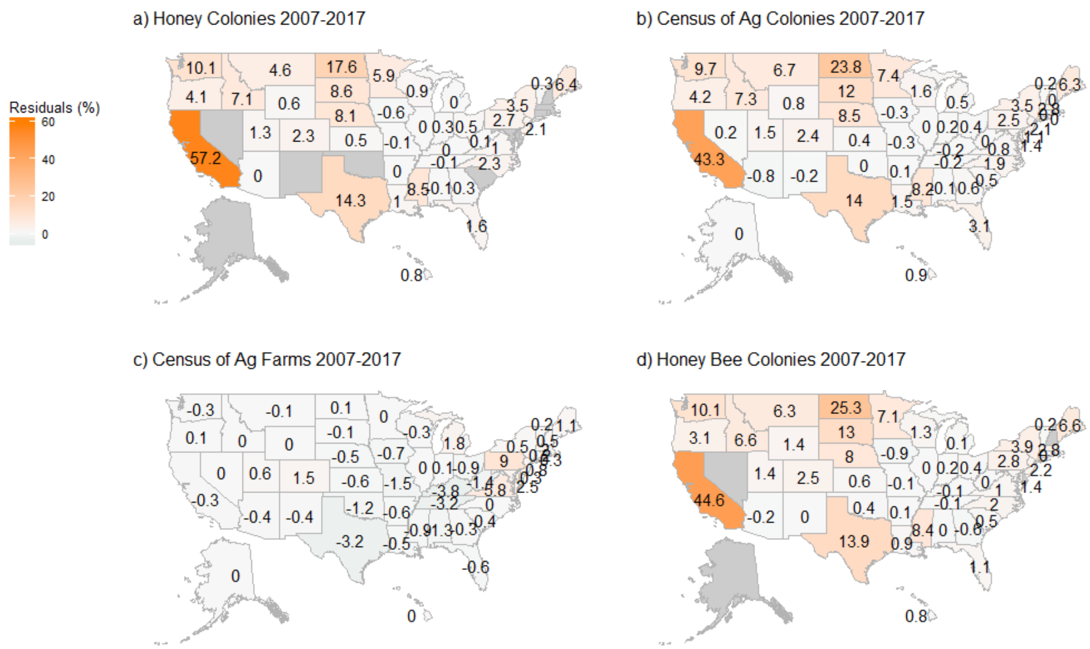
Colonies report is shown for illustrative purpose only as this recent survey has only been available in the last 2 years. Yet, in those 2 years, our sample represented between 12 and 15% of the estimated total number of colonies managed on October 1st in the US.

The subset of respondents used to estimate Summer Loss were based on between 2,398 and 5,963 operations, with a median of 4,238 operations per year. Together, they managed between ~119,000 and 509,000 colonies on April 1st, with a median of ~370,000 colonies per year. In the 7 years that Summer Loss were recorded, our respondent represented ~11% of the national operations and %10 of the national number of colonies (as compared to NASS census data), or ~12% of the honey producing colonies (as compared to NASS Honey Report). Again, this representation varied across years, with the lowest numbers of operations and colonies represented in the survey years 2010-11 and 2011-12 before the summer and annual demographics were moved from the follow-up to the main section of the survey. In the last 2 survey years for which NASS Bee Colonies report were issued, our sample represented between 11 and 14% of the estimated total number of colonies managed on April 1st in the US.

Annual Loss were calculated only for operations which provided valid demographic information for both summer and winter of that survey year, which is why the total sample size for Annual Loss is lower than the sample size for Summer Loss. The number of operations varied between 2,361 and 5,733, with a median of 4,130 operations per year. Together, they managed between ~109,000 and 494,000 colonies on April 1st, with a median of ~338,000 colonies per year. They represented ~11% of the national operations and ~9% of the national number of colonies (as compared to NASS census data), or ~12% of the honey producing colonies (as compared to NASS Honey Report). In the last 2 survey years for which NASS Bee Colonies report were issued, our sample represented between 11 and 13% of the estimated total number of colonies managed on April 1st in the US.

Distribution by State

The relative apportionment of farms and colonies among states for each survey year are shown in 0, and summarized in a ten year average distributions shown in Figure 4.1. Overall, the number of operations in our survey was relatively well apportioned, with the exception of a few states. As expected, a few East Coast states were over-represented by the number of respondents, mostly Pennsylvania, Virginia and Maryland. On the other hand, Texas, Kentucky and Tennessee were relatively underrepresented in our respondent pool. In regards to the distribution of colonies, the comparison was less evident: colonies from beekeepers managing bees in more than one states are allocated in each of the states concerned, though they were not double counted at the national level. States which are typically associated with intensive migratory beekeeping were shown as highly overrepresented in our respondents' colony pool, mostly California, but also North Dakota, Texas, South Dakota and some others. Though NASS Honey Report also counts colonies in each state where honey was pulled, migratory colonies are not systematically extracted for their honey. In the Census of Ag report, colonies are associated with the state in which the farmer had the most revenue. In our survey, we do not have any objective information that would allow us to assign multi-states colonies to any specific state. The residuals of BIP's distribution of colonies compared to NASS most recent "Honey Bee Colony" surveys point in the same directions. Altogether, this indicates the need to treat estimates of multi-states operations separately when estimating State-level losses. National estimates should be relatively unaffected as those operations are not duplicated at the national level.



<u>Figure 4. 1:</u> BIP Surveys' residuals to the estimated relative allotment of beekeepers and colonies between US states a) based on Honey producing colonies estimates from NASS Honey Reports (2007 to 2016); b) based on total colony estimates, and c) operation estimates, from NASS Census of Agriculture (with extrapolated numbers between the censuses 2007 and 2012); d) based on Colonies on October 1st from the Honey Bee Colony Report from NASS (BIP numbers compared to years 2015 and 2016 only).

Population structure by operation size

Most respondents (94.6%) were characterized as backyard beekeepers (managing up to 50 colonies on October 1st), but they only managed a small fraction (6.1%) of the total colonies represented in the survey. Most colonies (88.4%) were managed in commercial operations (more than 500 colonies on October 1st) which only accounted for 2% of the total respondents. In between those 2 extremes, sideline beekeepers (managing between 51 and 500 colonies on October 1st) gathered 3.4% of the respondents and 5.4% of the total colonies. This population structure was relatively constant throughout the years with the exception of the first two iterations of the survey (Figure 4.2). This structure is typical of the US beekeeper's population, as confirmed by similar proportions reported in NASS 2012 Census (84.6% of the colonies managed by 2.8% of the beekeepers in operations of more than 500 colonies, 6.0% of the colonies managed by 92.7% of the beekeepers in operations of 50 or less, and 9.4% of the colonies managed by the remaining 4.5% of beekeepers) (0). The divergences between BIP's and NASS population structure, though relatively small, were in the direction predicted.

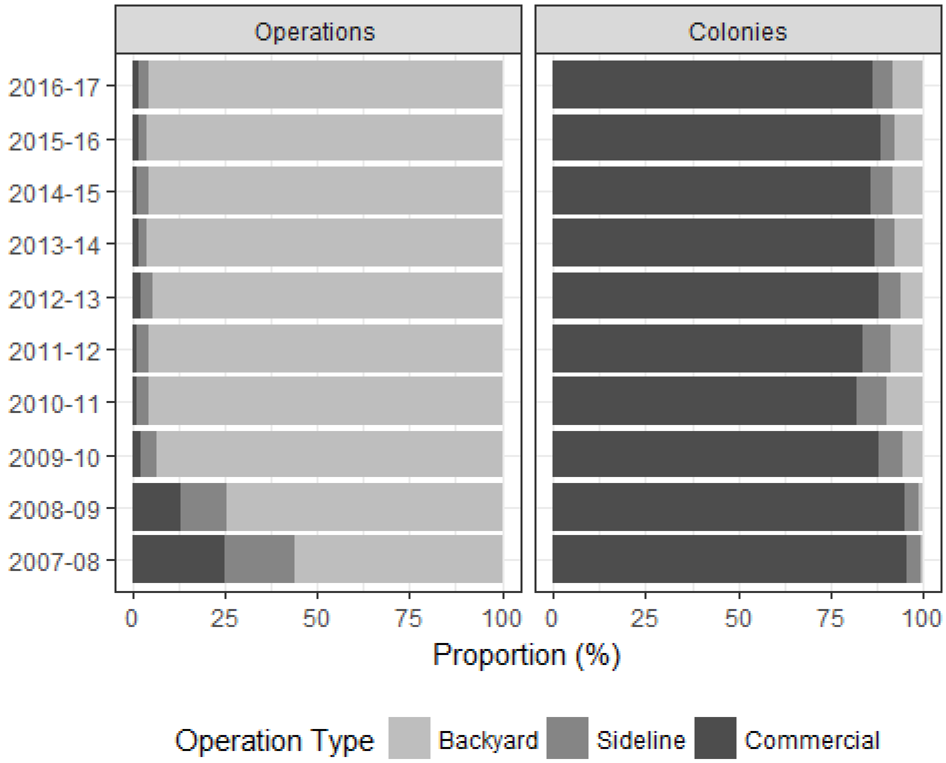


Figure 4.2: Respondents' population structure. Proportion of number of operations and colonies compared to the total for each respective survey year, with operations grouped by operation size, for operations of 1-50 (Backyard), 51-500 (Sideline) and 501 or more (Commercial).

Operational Loss estimates

The level of loss experienced by the survey respondents ranged the full extent from 0% to 100% (see probability distribution in Figure 4.3). Backyard beekeepers displayed a tri-modal distribution of loss over the winter and the whole year, with peaks at 0, 50 and 100% loss. This distribution is typical of a binomial distribution of probabilities with small number of trials (*i.e.* few colonies per respondent).

Their distribution of Summer Loss however, was largely unimodal, with most backyard beekeepers (61%) reporting no loss (median and mode). Backyard beekeepers lost on average 14.24 ± 0.14% (s.e.) over the summer (Table 4 - 2). Over

60% of backyard beekeepers reported no loss over the summer. Over the winter, backyard beekeepers lost on average 40.66 ± 0.18%, with a median of 33.33% loss. About one third of backyard beekeepers (31%) reported no loss over the winter throughout the years. Annual loss averaged 46.49 ± 0.21% with a median of 50% for backyard beekeepers. Still 21% of them reported no loss over the entire season. Sideline and commercial operations displayed a similar pattern of operational loss, with largely unimodal and right-side skewed distributions. Sideline beekeepers lost on average 14.25 ± 0.57%, 33.89 ± 0.64% and 40.86 ± 0.85% of their colonies over the summer, winter and annually. If 27% of them did not report any loss over the summer, only 4% reported no loss over the winter, and 1% over the whole year. Commercial beekeepers lost on average 19.9 ± 0.72%, 27.54 ± 0.67% and 36.8 ± 0.9% of their colonies over the summer, winter and annually. Close to 10% of them did not report any loss over the summer, 5% reported no loss over the winter, and 1% over the whole year.

Table 4 - 2: Seasonal summaries of operational loss by operation type

Survey Year	Operation Type	Season	N	N backyard	N sideline	N commercial	Total Col Start	Average Loss (±s.e.)	Total Col At Risk	Total Col Lost	Total Loss [95% CI]
All	All	Summer	29,908	28,456	916	536	2,278,348	14.34 ± 0.13	3,200,627	708,107	22.12 [21.91 - 22.33]
All	All	Winter	46,841	44,311	1,588	942	4,420,549	40.17 ± 0.17	5,395,569	1,503,123	27.86 [27.68 - 28.04]
All	All	Annual	28,898	27,495	894	509	2,170,684	46.15 ± 0.2	3,493,424	1,354,502	38.77 [38.53 - 39.02]
All	backyard	Summer	28,456	28,456	0	0	136,827	14.24 ± 0.14	221,792	38,787	17.49 [17.22 - 17.76]
All	sideline	Summer	916	0	916	0	106,583	14.25 ± 0.57	168,460	35,199	20.89 [19.51 - 22.33]
All	commercial	Summer	536	0	0	536	2,034,938	19.9 ± 0.72	2,810,375	634,121	22.56 [21.08 - 24.1]
All	backyard	Winter	44,311	44,311	0	0	270,677	40.66 ± 0.18	292,514	112,691	38.52 [38.23 - 38.82]
All	sideline	Winter	1,588	0	1,588	0	240,492	33.89 ± 0.64	269,864	89,866	33.3 [32.08 - 34.53]
All	commercial	Winter	942	0	0	942	3,909,380	27.54 ± 0.67	4,833,191	1,300,566	26.91 [25.75 - 28.09]
All	backyard	Annual	27,495	27,495	0	0	131,484	46.49 ± 0.21	227,567	106,330	46.72 [46.36 - 47.09]
All	sideline	Annual	894	0	894	0	101,574	40.86 ± 0.85	177,657	78,346	44.1 [42.45 - 45.76]
All	commercial	Annual	509	0	0	509	1,937,626	36.8 ± 0.9	3,088,200	1,169,826	37.88 [36.15 - 39.63]
2010-11	All	Summer	2,398	2,298	63	37	118,957	11.86 ± 0.4	162,884	29,727	18.25 [17.61 - 18.91]
2011-12	All	Summer	3,286	3,117	122	47	176,635	10.51 ± 0.31	234,790	40,606	17.29 [16.7 - 17.9]
2012-13	All	Summer	4,177	3,894	173	110	508,985	12.51 ± 0.29	719,450	181,825	25.27 [24.8 - 25.75]
2013-14	All	Summer	5,963	5,695	165	103	397,773	15.11 ± 0.31	565,635	112,109	19.82 [19.35 - 20.3]
2014-15	All	Summer	4,971	4,751	140	80	370,063	14.67 ± 0.33	548,455	138,755	25.3 [24.7 - 25.91]
2015-16	All	Summer	4,875	4,670	116	89	399,055	16.5 ± 0.36	537,842	126,675	23.55 [23.03 - 24.08]
2016-17	All	Summer	4,238	4,031	137	70	306,880	16.58 ± 0.38	431,571	78,410	18.17 [17.65 - 18.69]
2007-08	All	Winter	506	284	96	126	477,298	26.31 ± 1.13	558,808	199,618	35.72 [33.87 - 37.6]
2008-09	All	Winter	777	578	98	101	461,980	34.25 ± 1.1	622,595	178,002	28.59 [27.49 - 29.71]
2009-10	All	Winter	4,212	3,942	171	99	436,354	42.39 ± 0.56	571,475	196,342	34.36 [33.71 - 35.01]
2010-11	All	Winter	5,556	5,322	170	64	326,763	38.41 ± 0.5	398,762	118,817	29.8 [29.19 - 30.41]
2011-12	All	Winter	5,466	5,222	178	66	353,359	25.4 ± 0.43	468,158	105,390	22.51 [22.1 - 22.92]

2012-13	All	Winter	6,486	6,117	233	136	646,008	44.77 ± 0.46	761,162	230,175	30.24 [29.75 - 30.73]
2013-14	All	Winter	7,193	6,899	186	108	505,242	44.75 ± 0.45	582,928	135,603	23.26 [22.84 - 23.69]
2014-15	All	Winter	5,937	5,690	169	78	414,267	43.71 ± 0.48	470,956	105,186	22.33 [21.87 - 22.8]
2015-16	All	Winter	5,725	5,499	137	89	427,652	37.74 ± 0.49	539,874	145,106	26.88 [26.39 - 27.37]
2016-17	All	Winter	4,983	4,758	150	75	371,626	44.75 ± 0.54	420,851	88,884	21.12 [20.6 - 21.64]
2010-11	All	Annual	2,361	2,264	62	35	108,944	40.59 ± 0.71	170,828	62,017	36.3 [35.32 - 37.3]
2011-12	All	Annual	3,256	3,089	121	46	172,964	30.92 ± 0.53	271,705	80,574	29.65 [28.99 - 30.33]
2012-13	All	Annual	4,130	3,856	170	104	493,739	50 ± 0.52	788,368	361,726	45.88 [45.28 - 46.49]
2013-14	All	Annual	5,733	5,474	160	99	382,883	50.73 ± 0.46	613,209	216,173	35.25 [34.78 - 35.73]
2014-15	All	Annual	4,775	4,566	136	73	337,633	49.04 ± 0.49	566,318	229,932	40.6 [39.96 - 41.24]
2015-16	All	Annual	4,624	4,426	114	84	373,710	44.18 ± 0.51	609,857	246,903	40.49 [39.88 - 41.09]
2016-17	All	Annual	4,019	3,820	131	68	300,811	50.06 ± 0.55	473,139	157,177	33.22 [32.57 - 33.88]
2010-11	backyard	Summer	2,298	2,298	0	0	10,924	11.76 ± 0.42	18,221	3,178	17.44 [16.47 - 18.44]
2010-11	sideline	Summer	63	0	63	0	7,393	11.81 ± 2.01	12,311	2,074	16.85 [12.24 - 22.24]
2010-11	commercial	Summer	37	0	0	37	100,640	18.37 ± 2.41	132,352	24,475	18.49 [14.1 - 23.5]
2011-12	backyard	Summer	3,117	3,117	0	0	14,697	10.3 ± 0.32	23,873	3,175	13.3 [12.68 - 13.94]
2011-12	sideline	Summer	122	0	122	0	13,908	13.03 ± 1.35	23,133	4,610	19.93 [16.46 - 23.73]
2011-12	commercial	Summer	47	0	0	47	148,030	17.82 ± 2.32	187,784	32,821	17.48 [12.91 - 22.78]
2012-13	backyard	Summer	3,894	3,894	0	0	19,983	12.18 ± 0.31	32,464	5,071	15.62 [15.02 - 16.24]
2012-13	sideline	Summer	173	0	173	0	22,834	15.08 ± 1.18	34,712	6,614	19.05 [16.5 - 21.8]
2012-13	commercial	Summer	110	0	0	110	466,168	20.38 ± 1.5	652,274	170,140	26.08 [23.33 - 28.97]
2013-14	backyard	Summer	5,695	5,695	0	0	26,903	15.12 ± 0.32	42,522	8,548	20.1 [19.39 - 20.83]
2013-14	sideline	Summer	165	0	165	0	18,519	12.79 ± 1.28	31,169	6,011	19.29 [16.05 - 22.83]
2013-14	commercial	Summer	103	0	0	103	352,351	18.71 ± 1.54	491,944	97,550	19.83 [16.57 - 23.38]
2014-15	backyard	Summer	4,751	4,751	0	0	22,096	14.55 ± 0.34	36,409	5,795	15.92 [15.32 - 16.53]
2014-15	sideline	Summer	140	0	140	0	16,043	14.7 ± 1.63	23,606	5,032	21.32 [17.84 - 25.1]

2014-15	commercial	Summer	80	0	0	80	331,924	21.59 ± 2.21	488,440	127,928	26.19 [21.62 - 31.14]
2015-16	backyard	Summer	4,670	4,670	0	0	21,679	16.45 ± 0.37	35,501	6,291	17.72 [17.08 - 18.38]
2015-16	sideline	Summer	116	0	116	0	11,275	15.11 ± 1.73	17,815	4,549	25.53 [20.76 - 30.74]
2015-16	commercial	Summer	89	0	0	89	366,101	21.13 ± 1.93	484,526	115,835	23.91 [20.33 - 27.75]
2016-17	backyard	Summer	4,031	4,031	0	0	20,545	16.55 ± 0.39	32,802	6,729	20.51 [19.74 - 21.31]
2016-17	sideline	Summer	137	0	137	0	16,611	15.97 ± 1.62	25,714	6,309	24.54 [20.87 - 28.47]
2016-17	commercial	Summer	70	0	0	70	269,724	19.6 ± 1.93	373,055	65,372	17.52 [14 - 21.47]
2007-08	backyard	Winter	284	284	0	0	2,914	22.9 ± 1.6	3,011	824	27.37 [24.42 - 30.45]
2007-08	sideline	Winter	96	0	96	0	17,681	28.71 ± 2.32	19,596	6,028	30.76 [26.44 - 35.32]
2007-08	commercial	Winter	126	0	0	126	456,703	32.17 ± 2	536,201	192,766	35.95 [32.28 - 39.73]
2008-09	backyard	Winter	578	578	0	0	4,845	35.54 ± 1.39	5,543	1,979	35.7 [33.46 - 37.99]
2008-09	sideline	Winter	98	0	98	0	18,616	32.9 ± 2.31	21,467	6,845	31.89 [27.45 - 36.56]
2008-09	commercial	Winter	101	0	0	101	438,519	28.13 ± 1.8	595,585	169,178	28.41 [25.48 - 31.46]
2009-10	backyard	Winter	3,942	3,942	0	0	24,514	42.57 ± 0.59	26,518	11,396	42.97 [42 - 43.95]
2009-10	sideline	Winter	171	0	171	0	28,386	42.58 ± 1.97	31,810	14,262	44.83 [41.01 - 48.7]
2009-10	commercial	Winter	99	0	0	99	383,454	34.99 ± 2.25	513,147	170,684	33.26 [29.36 - 37.33]
2010-11	backyard	Winter	5,322	5,322	0	0	31,712	38.64 ± 0.51	34,102	13,215	38.75 [37.89 - 39.62]
2010-11	sideline	Winter	170	0	170	0	26,134	35.14 ± 2.13	28,626	9,787	34.19 [30.08 - 38.47]
2010-11	commercial	Winter	64	0	0	64	268,917	27.68 ± 2.79	336,034	95,815	28.51 [23.47 - 33.95]
2011-12	backyard	Winter	5,222	5,222	0	0	30,697	25.57 ± 0.45	34,616	8,563	24.74 [24.01 - 25.47]
2011-12	sideline	Winter	178	0	178	0	27,438	22.12 ± 1.38	31,115	6,959	22.37 [19.96 - 24.9]
2011-12	commercial	Winter	66	0	0	66	295,224	20.6 ± 2.23	402,427	89,868	22.33 [19.09 - 25.82]
2012-13	backyard	Winter	6,117	6,117	0	0	39,451	45.4 ± 0.48	42,905	18,341	42.75 [41.97 - 43.53]
2012-13	sideline	Winter	233	0	233	0	35,937	36.91 ± 1.71	40,247	14,329	35.6 [32.44 - 38.85]
2012-13	commercial	Winter	136	0	0	136	570,620	30.01 ± 1.88	678,010	197,505	29.13 [26.09 - 32.3]
2013-14	backyard	Winter	6,899	6,899	0	0	39,197	45.27 ± 0.46	41,950	18,273	43.56 [42.79 - 44.33]

2013-14	sideline	Winter	186	0	186	0	27,288	38.87 ± 2.02	30,193	10,733	35.55 [31.82 - 39.4]
2013-14	commercial	Winter	108	0	0	108	438,757	21.85 ± 1.57	510,785	106,597	20.87 [18.22 - 23.7]
2014-15	backyard	Winter	5,690	5,690	0	0	34,569	44.35 ± 0.49	36,846	15,173	41.18 [40.37 - 41.99]
2014-15	sideline	Winter	169	0	169	0	23,024	31.76 ± 1.9	25,810	7,972	30.89 [27.21 - 34.73]
2014-15	commercial	Winter	78	0	0	78	356,674	22.9 ± 2.09	408,300	82,041	20.09 [16.93 - 23.53]
2015-16	backyard	Winter	5,499	5,499	0	0	33,254	38.15 ± 0.5	35,240	12,102	34.34 [33.52 - 35.17]
2015-16	sideline	Winter	137	0	137	0	15,705	28.68 ± 2.08	18,334	5,213	28.43 [24.57 - 32.52]
2015-16	commercial	Winter	89	0	0	89	378,693	26.27 ± 2.07	486,300	127,791	26.28 [22.77 - 30]
2016-17	backyard	Winter	4,758	4,758	0	0	29,524	45.31 ± 0.56	31,783	12,825	40.35 [39.41 - 41.3]
2016-17	sideline	Winter	150	0	150	0	20,283	36.77 ± 2.11	22,666	7,738	34.14 [30.29 - 38.13]
2016-17	commercial	Winter	75	0	0	75	321,819	25.19 ± 2.27	366,402	68,321	18.65 [15.41 - 22.2]
2010-11	backyard	Annual	2,264	2,264	0	0	10,711	40.72 ± 0.74	19,024	8,668	45.56 [44.28 - 46.85]
2010-11	sideline	Annual	62	0	62	0	7,293	37.88 ± 3.43	12,838	5,612	43.71 [36.8 - 50.8]
2010-11	commercial	Annual	35	0	0	35	90,940	36.82 ± 3.86	138,966	47,737	34.35 [27.04 - 42.2]
2011-12	backyard	Annual	3,089	3,089	0	0	14,496	30.94 ± 0.56	26,200	8,605	32.84 [31.91 - 33.78]
2011-12	sideline	Annual	121	0	121	0	13,638	31.13 ± 1.77	25,712	9,460	36.79 [33.35 - 40.33]
2011-12	commercial	Annual	46	0	0	46	144,830	28.89 ± 2.96	219,793	62,509	28.44 [23.3 - 33.99]
2012-13	backyard	Annual	3,856	3,856	0	0	19,751	50.41 ± 0.55	34,491	17,283	50.11 [49.19 - 51.03]
2012-13	sideline	Annual	170	0	170	0	22,000	45.77 ± 1.9	37,723	17,534	46.48 [42.93 - 50.05]
2012-13	commercial	Annual	104	0	0	104	451,988	41.91 ± 2.07	716,154	326,909	45.65 [42 - 49.32]
2013-14	backyard	Annual	5,474	5,474	0	0	25,677	51.22 ± 0.48	42,626	22,194	52.07 [51.24 - 52.89]
2013-14	sideline	Annual	160	0	160	0	17,555	44.75 ± 2.14	32,838	15,156	46.15 [41.97 - 50.37]
2013-14	commercial	Annual	99	0	0	99	339,651	33.61 ± 1.65	537,745	178,823	33.25 [30.28 - 36.32]
2014-15	backyard	Annual	4,566	4,566	0	0	21,106	49.53 ± 0.51	36,935	17,897	48.46 [47.6 - 49.32]
2014-15	sideline	Annual	136	0	136	0	15,643	39.14 ± 2.2	25,047	10,838	43.27 [38.82 - 47.79]
2014-15	commercial	Annual	73	0	0	73	300,884	37.3 ± 2.47	504,336	201,197	39.89 [35.01 - 44.92]

2015-16	backyard	Annual	4,426	4,426	0	0	20,530	44.45 ± 0.52	35,512	15,444	43.49 [42.6 - 44.39]
2015-16	sideline	Annual	114	0	114	0	9,771	37.62 ± 2.41	16,869	7,023	41.63 [36.54 - 46.85]
2015-16	commercial	Annual	84	0	0	84	343,409	38.76 ± 2.29	557,476	224,436	40.26 [36.01 - 44.61]
2016-17	backyard	Annual	3,820	3,820	0	0	19,213	50.49 ± 0.58	32,779	16,239	49.54 [48.54 - 50.54]
2016-17	sideline	Annual	131	0	131	0	15,674	44.75 ± 2.14	26,630	12,723	47.78 [43.8 - 51.77]
2016-17	commercial	Annual	68	0	0	68	265,924	35.98 ± 2.34	413,730	128,215	30.99 [26.58 - 35.65]

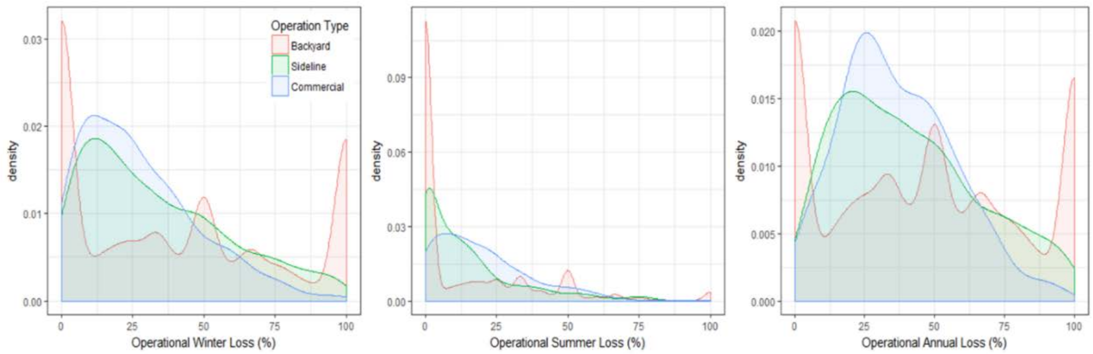


Figure 4.3: Probability distribution curves of Operational Loss by season and operation type

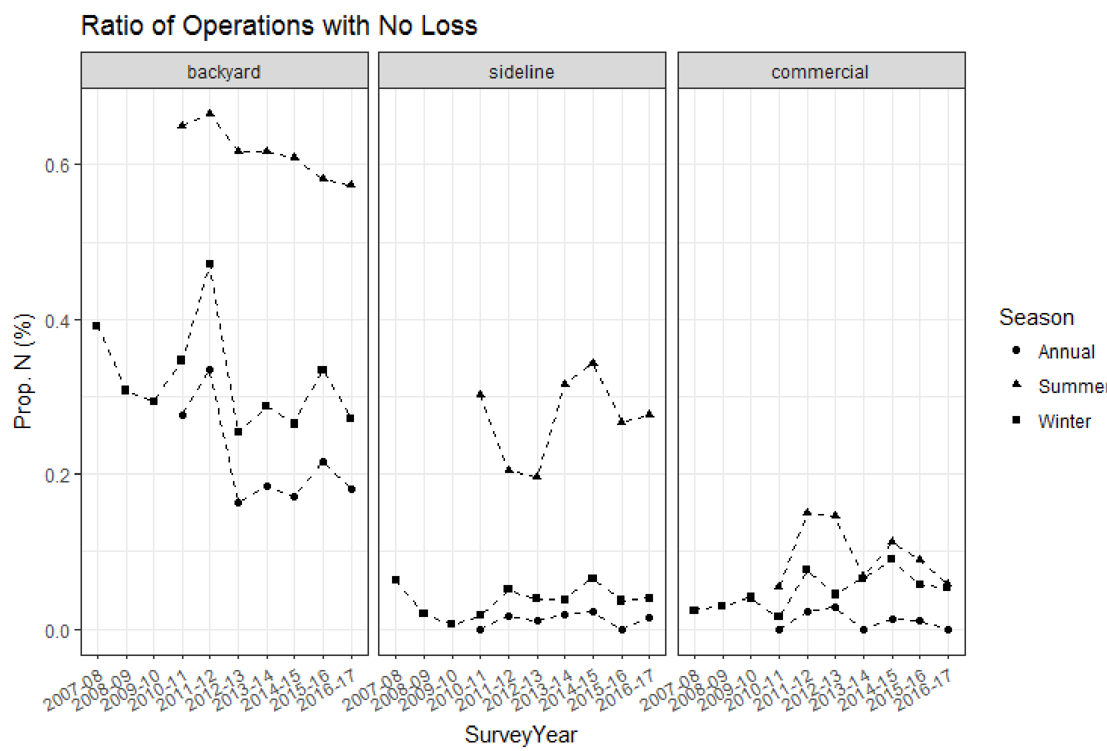


Figure 4.4: Proportion of operations reporting no loss over a specific season

The proportion of beekeepers reporting no loss over a specific season has varied over time (Figure 4.4). We identified significant negative trends for backyard beekeepers in all three seasons (Chi^2 test for trend in proportions, Chi^2=103.6, 83.8, 147.8 respectively for winter, summer and annual trends, df=1, all p-values<0.001), as well as a slight positive trend for commercial beekeepers over the winter (Chi^2=4.3, df=1, p-value=0.039). All other suites of proportions were non-significant for a linear change over time.

Since 2008-2009, beekeepers were asked to indicate what level of overwintering loss they would deem acceptable. The average acceptable overwintering loss has fluctuated over the years around 16.71% ± 0.09 (Figure 4.5). Over all years, over 60% of beekeepers reported overwintering losses in excess to what they would deem acceptable. Sideline beekeepers were more likely (70%) to report unacceptable levels of winter loss than the other two types of operations (RR=1.15, 95% CI [1.11-1.19] and RR=1.11, 95% CI [1.04-1.18] compared to backyard and commercial beekeepers).

The proportion of operations reporting losses lower than their self-reported level of acceptability has decreased over the years for backyard beekeepers (Chi^2=10.9, df=1, p-value<0.001) but not for the other operations types (Chi^2=2.5 and 1.2 for sideline and commercial operations, df=1.p-value=0.12 and 0.28).

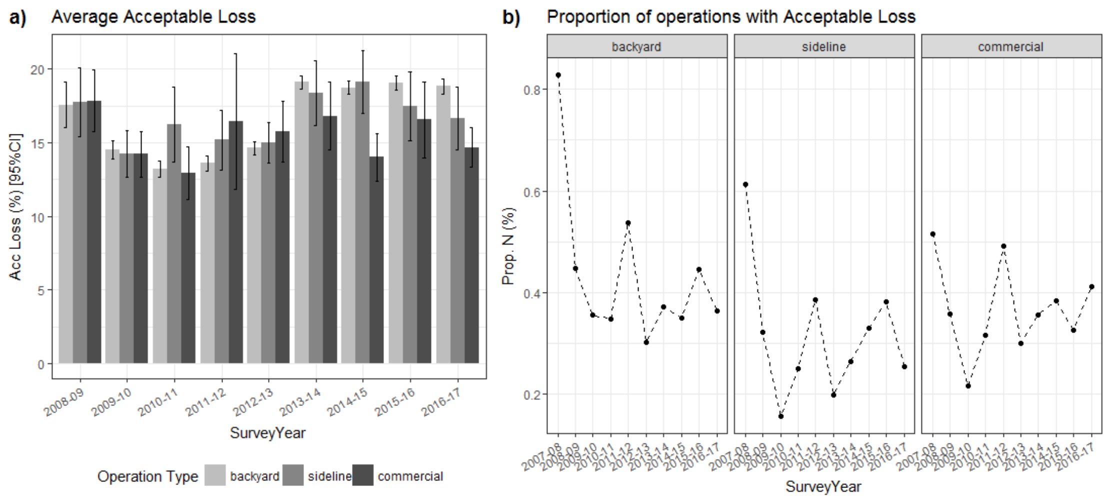


Figure 4.5: Acceptable Winter Loss a) Average acceptable overwinter loss by operation size and survey year; b) Proportion of operations reporting acceptable losses (compared to own standards).

Sub-populations Total and Average Loss estimates

Operation type-specific estimates

The risk of colony mortality varied between operation type in a relatively consistent manner (Table 4 - 2, Figure 4.6). Backyard beekeepers experienced heavier colony mortalities in the winter compared to other operation types, while commercial beekeepers lost a higher proportion of their colonies over the winter.

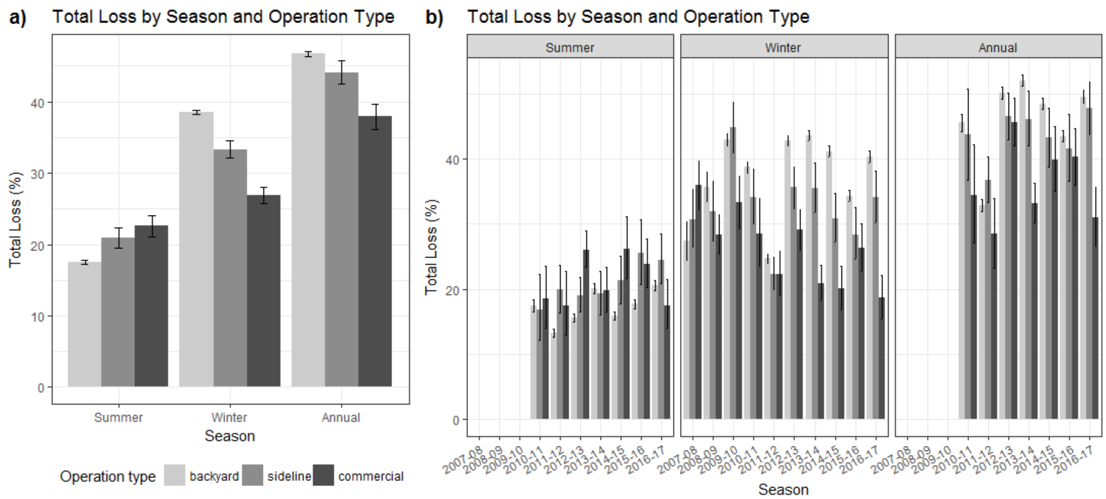


Figure 4.6: Observed Risk of colony mortality by Operation type a) all years combined, b) by survey year.

There was a significant interaction term in the error structure of the mixed effect model testing the impact of Operation Type on Winter Loss (m3 vs m1, Test by deletion, ML, Chi^2=11636, df=5, p<0.001)(Table 4 - 3). This indicated that the model best fit the data while accounting for variations in Winter Loss across years specifically for each operation type. After controlling for those random effects, operation type was still identified as a significant fixed effect in our model (m3 vs m2, Test by deletion, ML, Chi^2=8.89, df=2, p=0.012) (Table 4 - 3). Backyard beekeepers were associated with significantly higher colony mortality over the winter than sideline beekeepers, themselves associated with higher colony mortality than commercial beekeepers (m3 mean predictions: 38.6%, 33.2%, and 27.1% for backyard, sideline and commercial respectively).

Similar conclusions were reached concerning the modelling of Summer and Annual Losses. The most performing model included operation type as part of the random effect (m3 vs m1, Test by deletion, ML, Chi^2= 4618.2 and 5864.9, df=5, p<0.001 for

Summer and Annual Loss models respectively) (Table 4 - 3). However, though operation type was significant as a fixed effect in both seasons (m3 vs m2, Table 4 - 3), the directionality of the effect was variable. Over the summer, backyard beekeepers were associated with significantly lower colony mortality than both sideline and commercial beekeepers (m3 mean predictions: 17.5%, 21.0%, and 22.1%). Over the entire annual season commercial beekeepers were associated with significantly lower colony mortality than both sideline and backyard beekeepers (m2 mean predictions: 46.8%, 44.0%, and 37.2% for backyard, sideline and commercial respectively).

Table 4 - 3: Model Structure and performance

Model	Fixed Effect	Random Effect	Df	deviance	Chisq	Chi Df	Pr(>Chisq)
Winter Losses		glmer(cbind(WinterLost,WinterAlive) ~			...		, family=binomial)
m0	1	(1|SurveyYear)	2	1140276			
m1	OperationType	(1|SurveyYear)	4	1111443	28832.971	2	< 2e-16
m2	1	(OperationType|SurveyYear)	7	1099816	11626.8402	3	< 2e-16
m3	OperationType	(OperationType|SurveyYear)	9	1099808	8.7899	2	0.01234
Summer Losses		glmer(cbind(SumerLost,SummerAlive) ~			...		, family=binomial)
m0	1	(1|SurveyYear)	2	687089			
m1	OperationType	(1|SurveyYear)	4	684654	2434.6779	2	< 2e-16
m2	1	(OperationType|SurveyYear)	7	680042	4611.7637	3	< 2e-16
m3	OperationType	(OperationType|SurveyYear)	9	680036	6.4102	2	0.04055
Annual Losses		glmer(cbind(AnnualLost,AnnualAlive) ~			...		, family=binomial)
m0	1	(1|SurveyYear)	2	749369			
m1	OperationType	(1|SurveyYear)	4	737003	12366.079	2	< 2e-16
m2	1	(OperationType|SurveyYear)	7	731147	5855.8031	3	< 2e-16
m3	OperationType	(OperationType|SurveyYear)	9	731138	9.0828	2	0.01066

State Estimates

There was remarkable variability in the levels of colony mortalities reported by different US States (Seasonal State Summaries by survey year provided in Appendix

2, Maps in Appendix 3). The number of respondents varied between states and years. Anecdotally, the most recent survey gathering one valid respondent from both the Virgin Islands and Guam. During this most recent year, State Total Losses varied from 0% (HI) to 77.1% (OK) over the Summer, 6.6% (MS) to 69.0% (DE) over the Winter, and from 15.9% (MA) to 83.9% (OK) over the entire year (Figure 4.7 to 9). States with 5 respondents or less were not included in the analyses of State-estimates.

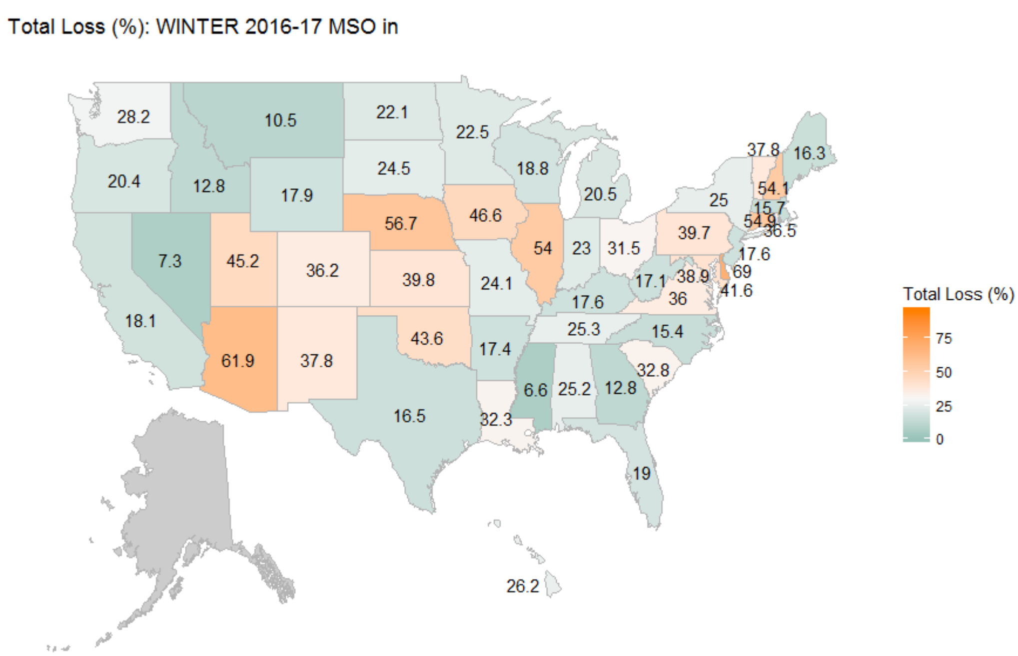


Figure 4.7: Total Winter Loss (%) for 2016-17, multi-state operations included

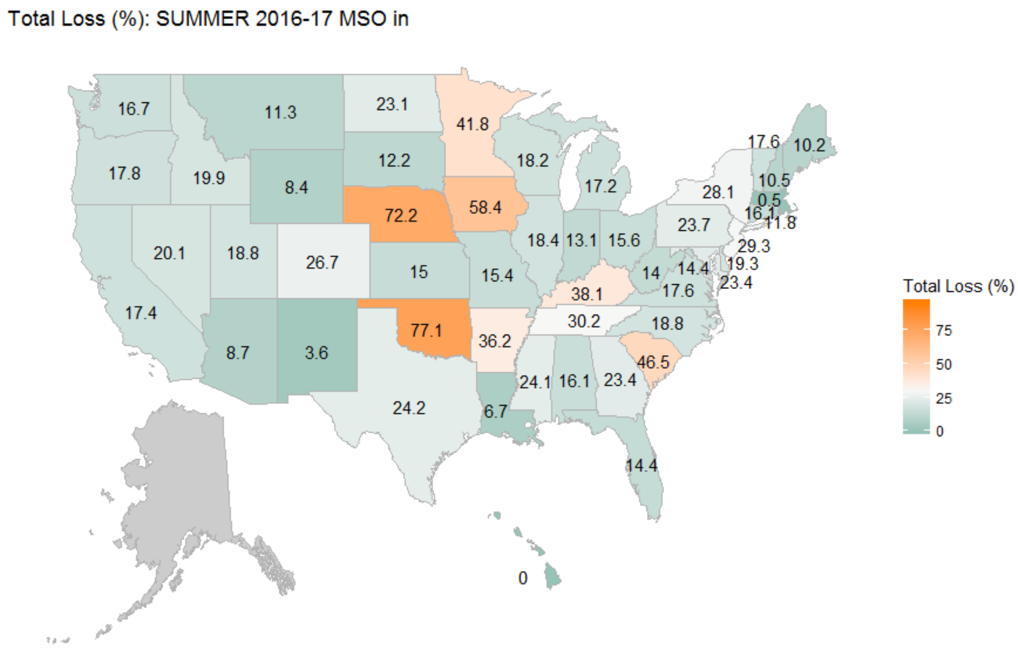


Figure 4.8: Total Summer Loss (%) for 2016-17, multi-state operations included

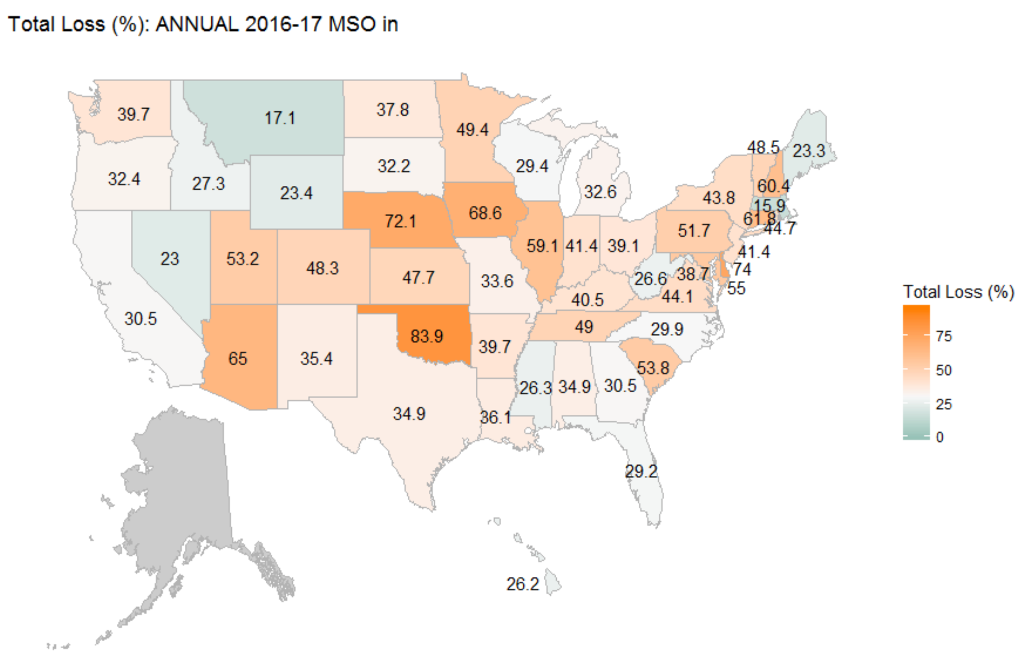


Figure 4.9: Total Annual Loss (%) for 2016-17, multi-state operations included

State estimates have varied over the years, as illustrated by the deviations from the national average (Figure 4.10, extract from Appendix 4). Some states were repeatedly experiencing levels of loss in excess to the average national levels (such as Total Winter Losses in CT beekeepers, Figure 4.10). The magnitude of the fluctuations also varied between states, with some remarkably constant (such as Total Winter Losses in CA beekeepers).

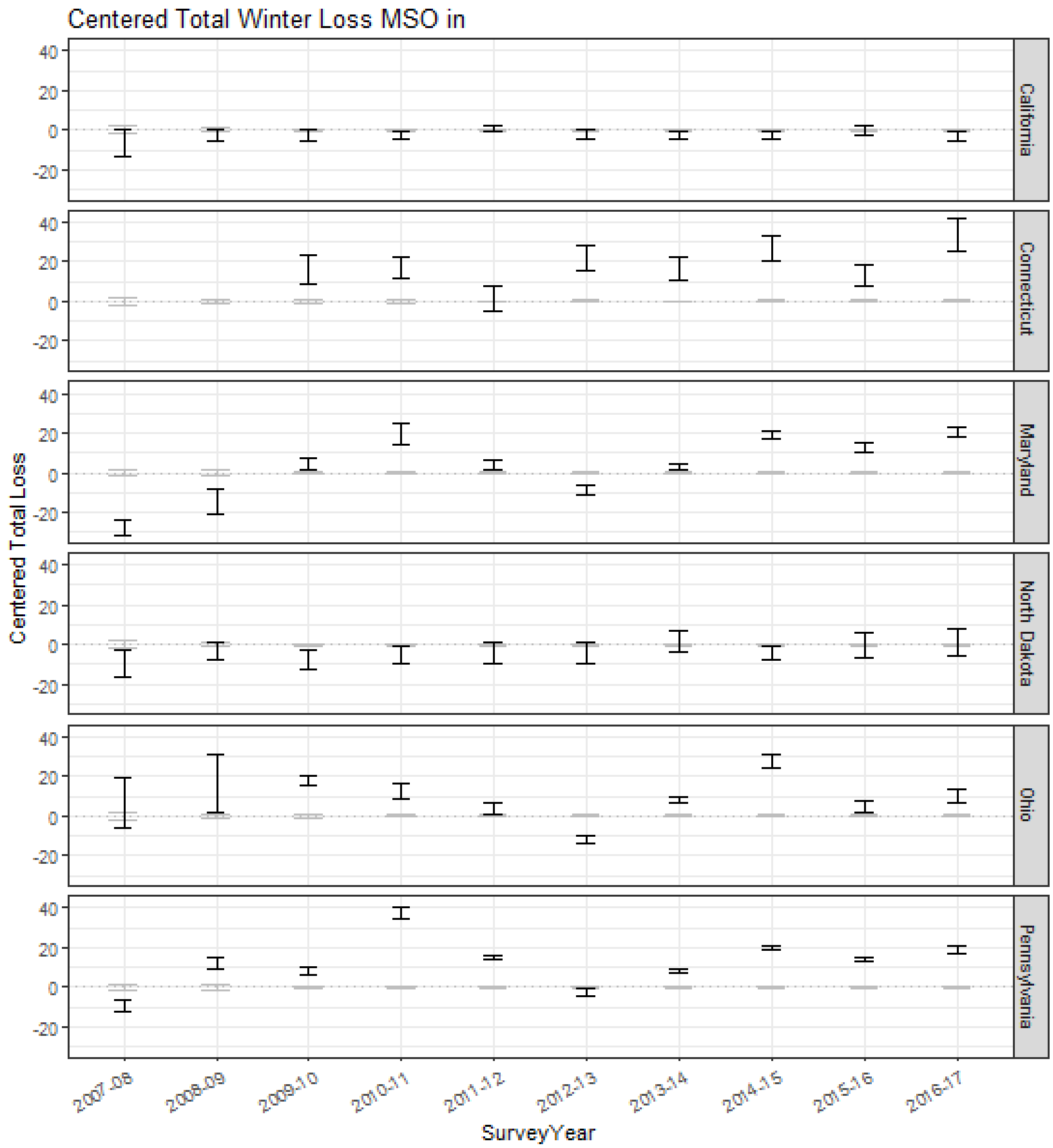


Figure 4.10: Centered Total Winter Loss State estimates (including multi-states operations) showing deviations from the national average

National crude and adjusted loss estimates

Our crude National Total Summer Loss estimates varied over the years from 17.3% (2011-12) to 25.3% (2014-15). The adjustments for state representation (method 1 and 2) and single-state/multi-state apportionment (method 2) modified our loss estimates from between -2.2 to 1.5 percentage points (Figure 4.11, Table 4 - 4).

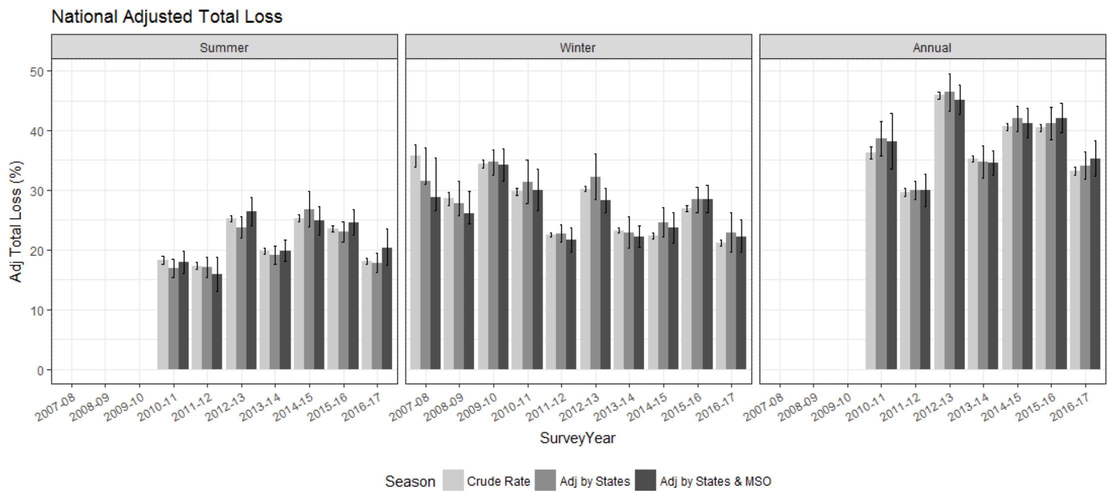


Figure 4.11: Crude and adjusted national estimates of colony loss

The National estimates for Total Winter Loss varied originally between 21.1% (2016-17) and 35.7% (2007-2008). The adjustments resulted in more consequent changes, with variation from -2.2 to 6.9 percentage points. The largest modification in our population estimate was associated with the first iteration of the survey. If we exclude that years, the adjustments resulted in -2.3 to 2.4 percentage point's difference. Our National Total Annual Loss estimates varied from 29.9% (2011-12) to 45.1% (2012-13) over the years. After adjustments, our estimates were modified from between -2.4 to 0.8 percentage points (Figure 4.11, Table 4 - 4).

Table 4 - 4: Crude and adjusted National Colony Loss Rates

Season	Survey Year	N	Total Col Start	Average Loss (±s.e.)	Total Loss [95% CI] (Crude Rate)	Adj Total Loss [95% CI] (method 1)	Adj Total Loss [95% CI] (method 2)
Summer	2010-11	2,398	118,957	11.86 ± 0.4	18.25 [17.61 - 18.91]	16.9 [15.4 - 18.48]	17.89 [16.02 - 19.87]
	2011-12	3,286	176,635	10.51 ± 0.31	17.29 [16.7 - 17.9]	17.08 [15.43 - 18.81]	15.85 [13.11 - 18.88]
	2012-13	4,177	508,985	12.51 ± 0.29	25.27 [24.8 - 25.75]	23.74 [21.99 - 25.56]	26.37 [24.08 - 28.74]
	2013-14	5,963	397,773	15.11 ± 0.31	19.82 [19.35 - 20.3]	19.06 [17.55 - 20.64]	19.83 [18.06 - 21.67]
	2014-15	4,971	370,063	14.67 ± 0.33	25.3 [24.7 - 25.91]	26.79 [23.86 - 29.86]	24.87 [22.55 - 27.29]
	2015-16	4,875	399,055	16.5 ± 0.36	23.55 [23.03 - 24.08]	23.03 [21.31 - 24.8]	24.6 [22.56 - 26.72]
	2016-17	4,238	306,880	16.58 ± 0.38	18.17 [17.65 - 18.69]	17.8 [16.25 - 19.43]	20.34 [17.39 - 23.52]
Winter	2007-08	506	477,298	26.31 ± 1.13	35.72 [33.87 - 37.6]	31.48 [31.09 - 37.1]	28.78 [26.6 - 35.37]
	2008-09	777	461,980	34.25 ± 1.1	28.59 [27.49 - 29.71]	27.82 [25.69 - 31.46]	26.15 [24.37 - 29.85]
	2009-10	4,212	436,354	42.39 ± 0.56	34.36 [33.71 - 35.01]	34.66 [32.59 - 36.77]	34.15 [31.44 - 36.93]
	2010-11	5,556	326,763	38.41 ± 0.5	29.8 [29.19 - 30.41]	31.41 [27.84 - 35.14]	30 [26.6 - 33.55]
	2011-12	5,466	353,359	25.4 ± 0.43	22.51 [22.1 - 22.92]	22.71 [21.26 - 24.2]	21.71 [19.73 - 23.79]
	2012-13	6,486	646,008	44.77 ± 0.46	30.24 [29.75 - 30.73]	32.21 [28.51 - 36.07]	28.25 [26.26 - 30.3]
	2013-14	7,193	505,242	44.75 ± 0.45	23.26 [22.84 - 23.69]	22.92 [20.36 - 25.62]	22.25 [20.48 - 24.1]
	2014-15	5,937	414,267	43.71 ± 0.48	22.33 [21.87 - 22.8]	24.6 [22.16 - 27.16]	23.68 [21.22 - 26.27]
	2015-16	5,725	427,652	37.74 ± 0.49	26.88 [26.39 - 27.37]	28.39 [26.28 - 30.56]	28.55 [26.33 - 30.83]
	2016-17	4,983	371,626	44.75 ± 0.54	21.12 [20.6 - 21.64]	22.83 [19.67 - 26.22]	22.26 [19.56 - 25.12]
Annual	2010-11	2,361	108,944	40.59 ± 0.71	36.3 [35.32 - 37.3]	38.67 [35.85 - 41.54]	38.16 [33.6 - 42.86]
	2011-12	3,256	172,964	30.92 ± 0.53	29.65 [28.99 - 30.33]	29.99 [28.42 - 31.6]	29.92 [27.29 - 32.65]
	2012-13	4,130	493,739	50 ± 0.52	45.88 [45.28 - 46.49]	46.41 [43.31 - 49.54]	45.1 [42.65 - 47.57]
	2013-14	5,733	382,883	50.73 ± 0.46	35.25 [34.78 - 35.73]	34.69 [32.05 - 37.4]	34.51 [32.48 - 36.57]
	2014-15	4,775	337,633	49.04 ± 0.49	40.6 [39.96 - 41.24]	42 [39.9 - 44.1]	41.25 [38.8 - 43.72]
	2015-16	4,624	373,710	44.18 ± 0.51	40.49 [39.88 - 41.09]	41.25 [38.56 - 43.98]	42.09 [39.59 - 44.61]
	2016-17	4,019	300,811	50.06 ± 0.55	33.22 [32.57 - 33.88]	34.1 [31.81 - 36.45]	35.27 [32.29 - 38.33]

Discussion

This is the eleventh consecutive survey to report honey bee colony mortality rates over the winter, and the sixth to report summer and annual colony losses. With 21.1% colonies lost over the winter, 2016-2017 was the lowest winter loss year on record. Total Summer Loss of 18.2% and Total Annual Loss of 33.2% were the second lowest estimates over the years. In the decade of Loss Surveys (2007 to 2017), US beekeepers lost an average of 27.8% of colonies over the winter (10 year average of Total Winter Loss, 95% CI 27.7-28%). There is however substantial variation in the level of colony loss experienced throughout the stakeholder's population, both geographically and by type of operation. Large-scale and long-term surveys such as this one, are important tools allowing us to better understand honey bee health and the challenges facing the beekeeping industry.

Throughout 10 years, over 47,000 operations were surveyed, and provided demographic data that we used to estimate Winter, Summer and Annual Colony Loss rates. The most conservative estimates indicate that our respondents represented over 11% of the US beekeepers and 10% or more of the US colonies (averaged over survey years). This means than both 1 in every 10 beekeepers and 1 in every 10 colonies in the US were represented in this survey.

Variation in the method of allocation of beekeepers to specific states complicates the direct comparison between BIP and NASS beekeepers' and colonies' distribution. Though states with a high prevalence of multi-state operations appear over-estimated in our respondent's pool (Figure 4.1), those colonies are not double counted in national estimates, and we account for their influence by providing State level estimates both with and without this migratory population (Appendix 2). The operation size structure of our respondent reflects the generally bipolar structure of the US stakeholder's population, with most of the colonies managed by a small minority of commercial beekeepers (Figure 4.2). This characteristic operation size dichotomy has been relatively stable throughout the survey years with the exception of the first two iterations of the survey, which were mostly conducted through phone interviews that specifically targeted large-scale operations. This is also reflected by the relatively low coverage of the NASS-estimated total US farms for those 2 years, compared to on-par coverage of the number of US colonies (Table 4 - 1). We note the direct increase in participation as soon as the survey was made available online (from 2009-10). The number of colonies represented in the survey however was relatively constant throughout the years, with might be due to large-scale beekeepers mostly responding through paper surveys after particular targeting, which remained constant throughout the years. This clearly indicates the importance of online availability of surveys to access small-scale beekeepers from across the US and the continued importance of personalized paper solicitation for large-scale stakeholders. As a consequences, analyses relying on Average Losses in which the importance of large-scale beekeepers is tempered by allotting each operation the same weight should be interpreted with caution for survey years 2007-08 and 2008-09.

If a large proportion of backyard beekeepers reported no colony loss (mostly over the Summer, but also over the Winter and entire year) (Figure 4.3), this proportion has significantly reduced over time (Figure 4.4). So has the proportion of backyard beekeepers reporting losses lower than their self-identified acceptable level (Figure 4.5).

Sideline and commercial operations are mathematically less likely to report zero losses. Only about 10% of large scale beekeepers report no loss over the summer (Figure 4.4). Contrarily to expectations, commercial beekeepers report levels of summer loss relatively on par to winter losses (Figure 4.6). Commercial beekeepers lost significantly more colonies over the summer than backyard beekeepers, but significantly less colonies over the winter and over the entire year (Figure 4.6). This might be indicative of a different strategy between those 2 types of stakeholders, in which commercial beekeepers actively “take their losses” in the fall, by combining weak colonies before winter.

Until recently, losses over the summer were disregarded. This result highlight the continuing need to monitor mortality rates throughout the season. In their newest survey documenting colony numbers over the year, NASS implemented a quarterly time period (USDA NASS, 2016, 2017b). Ideally, changes in operation size should be documented in a more granular time scale. The honey bee colony losses presented in this report are akin to “all-cause” mortality rates in other organisms. In other words, our estimate reflects the risk of colonies loss from all causes, such as disease but also mismanagement, predation, accident, etc. A particularity of honey bee systems is the modularity of the colony unit: it is not unusual for beekeepers to combine weak colonies in the fall (thereby actively reducing their colonies units) to improve their odds of surviving the winter. This practice of consolidation of colonies in the fall constitutes a mathematical loss of colonies despite an absence of “dead-out”. Studies on colony loss would beneficiate from higher frequency of estimates compared to the present bi-semester estimates, if survey fatigue would allow for it.

State estimates of colony loss were extremely variable (2016-17 survey year in Figure 4.7 to 9, all state tables in Appendix 2 and maps in Appendix 3). Because Total Loss is weighted on colony numbers, those estimates are more closely associated with large-scale operations, whereas Average Loss estimates are more representative of the level of loss experienced by the “average” small-scale beekeeper. In other surveys, all colonies from multi-state operations were accounted in each state in which the operation kept colonies over the year. Given the nature of the migratory beekeeping industry, and their prevalence in our total stakeholder’s and respondent’s population, it is difficult to assign colonies “at risk” or “lost” to a specific state. To account for this incertitude, we presented estimates for multi-state operations as their own category, and allocated the fraction of the State estimates of Total Loss between colonies exclusive to the State and multi-state colonies (Appendix 2).

State estimates have also varied markedly over the years of the survey, though the magnitude of those variations are also dependent of the State (Figure 4.10, extract from Appendix 4). Further analyses will investigate whether states of close proximity (such as MD and PA, Figure 4.10) but also similar stakeholders’ structure (by operation size) share similarities in their trends.

To account for potential misrepresentation between beekeepers, we calibrated our Loss estimates to a shared population structure. The resulted adjusted National Estimates, corrected for representation of States and multi-states colonies, were within 3 percentage points of our crude estimates, with the highest effects limited to the first two iterations of the survey before the use of the online platform. This reassured us that our national estimates' variation across years were not an effect of change in the representation of our respondents.

As a managed population, mortality rate of honey bee colonies is a more direct measure of their health than population size (number of colonies). While population size is directly impacted by socio-economic drivers, mostly through artificial colony production rates (vanEngelsdorp and Meixner, 2010), mortality rates are impacted by biological and environmental drivers affecting honey bee health. The long investment in this survey series contributes to the further understanding of honey bee colony health. In particular, it demonstrated the variability in the practice of beekeeping in the USA and the diversity of risk levels associated with various groups of beekeepers.

Chapter 5: Prioritizing Best Management Practices for US beekeepers

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Abstract

To guarantee productivity, producers attempt to provide managed species an environment and diet that minimize stress and maximize health. While in many systems, including honey bees, individual practices are regularly tested and optimized, the effect of suites of management practices carried out simultaneously in real world conditions are simply not studied. Investigation of sets of management practices has been frustrated by the lack of a methodology to handle large complex and incomplete datasets that are typical in observational studies. Here, we propose a method to investigate the impact of management quality in a holistic view, using large retrospective stakeholder management surveys to test expertise-based hypotheses and identify suits of improved management practices associated with the highest reduction in overwinter colony mortality risk. This methodology allows us to validate the opinion of experts and prioritize recommendations as changes in management practices that are likely to produce the biggest impact on health for specific populations of beekeepers.

Using observational data obtained from the Bee Informed Partnership monitoring of honey bee colony losses and management practices in the US we were able to summarize management information into a quality index, based on experts' opinion, and test this index as an indicator of operational overwintering success. Further, by preforming sensitivity analyses that were internally validated with bootstrapping, we were able to rank individual practices based on their associated potential reduction in colony mortality risk. Globally, we found that a majority of beekeepers could expect the greatest reduction in mortality risk by modifying their behavior in terms of comb management, source of new colonies and *Varroa* management. Finally, we performed the same analysis on different subsets of beekeepers to identify specific optimal suites of management practices recommendations for each subset based on operation size and region. Among the specific recommendations for each subset, small-scale beekeepers would benefit most by prioritizing *Varroa* control, while professional beekeepers should prioritize *Varroa* monitoring.

While we tested out our methods on an extensive honey bee survivorship and management data set, we believe they could benefit other Ag or epidemiological systems interested in the summarization of a great number of practices and their prioritization based on highest potential to reduce risk.

Keywords: multicriteria analysis, variable prioritization, sensitivity analysis, expert elicitation, beekeeping, best management practices, honey bee health, *Apis mellifera*.

Introduction

Management practices impact the health and productivity of livestock (Cronin et al., 2014; Huneau-Salauen et al., 2015; Mitchell et al., 2012), either directly or indirectly, through their potential to alleviate or accentuate environmental stressors. Livestock usually benefit from a more protected environment, both against predators and environmental conditions, together with a more pro-active protection of health. On the other hand, management can have negative consequences for the animal, resulting from increased densities, restricted reproduction or limited choice of living environment (Cronin et al., 2014). Honey bees are considered a semi-managed species, being both housed in a human-made structures and subject to partial control of their gene flow, and free-ranging from the surrounding environment.

Managed honey bees (*Apis mellifera* L.) are a complex and highly valued study system. These livestock not only produce honey, but represent the most important pollinator force (estimated at over $16 billion in 2009 (Calderone, 2012)) of pollination-dependent crops. Honey bees are subject to many different stressors, from parasites and pathogens, to pesticides and poor nutrition (Potts et al., 2010a; vanEngelsdorp and Meixner, 2010), all of which acting concomitantly and potentially interacting. If some of these variables are not directly under beekeepers' control (*e.g.* climate, external pesticide applications, habitat quality), other can be directly regulated through management. Arguably the most important driver of losses, because of its high impact and prevalence, is *Varroa*, a parasitic mite that directly parasitizes adult and immature bees and transmits a series of viruses (Genersch, 2010). Without regular intervention from a beekeeper, most uncontrolled colonies in temperate climates would collapse from *Varroa* pressure in less than 3 years (Rosenkranz et al., 2010).

With high levels of honey bee colony loss experienced in the USA (Kulhanek et al., 2017; K. V. Lee et al., 2015; Seitz et al., 2015; Spleen et al., 2013; Steinhauer et al., 2014; vanEngelsdorp et al., 2007, 2008, 2010, 2011b, 2012) and around the world (Antúnez et al., 2017; Pirk et al., 2014; van der Zee et al., 2012, 2014) there is demand for a list of best management practices, or suites of management practices, which are optimal for colony survivorship (The Pollinator Health Task Force et al., 2015).

Methodologies to test individual or a small number of different management practices effect on health outcomes are well established; for instance, monitoring of *Varroa* after treatment, disinfection of hive woodenware and supplemental feeding have been associated to reduced *Varroa* infestations (Giacobino et al., 2014), replacement of old combs with reduced viral prevalence (Molineri et al., 2017) and queen replacement with reduced overwinter mortality (Giacobino et al., 2016b).

However, given the variety of stressors impacting honey bee colonies all throughout their extended range, those best practices are likely to vary in relative importance in different regions (*e.g.*, preparation for winter, or control of Small Hive Beetle is likely region-dependent). In addition, many practices are influenced by external variables like temperature (*e.g.*, some varroaides, such as formic acid, work optimally in a limited temperature range). Finally, there is already a high variability in what is considered “standard practices” among operations of different sizes, production goals and regions, which should be taken into account to determine what recommendation(s) would represent the highest potential gain in risk reduction. All of those aspects renders traditional testing approaches impractical, and generalization difficult.

In this paper, we offer a methodology to identify suites of improved management practices associated with the highest reduction in overwinter colony mortality risk for specific populations of beekeepers. This methodology combines the interests of summarizing complex management information, testing the association to mortality risk in real-life conditions, and integrating information about the prevalence of practices to prioritize recommendations based on highest potential gain for the targeted population.

Practically, we summarized the management practices employed in one operation into a simple metric – a Management Index – based on their comparison to an ideal set of practices determined by a panel of experts. The performance of the index was tested through its association to operational overwintering colony loss. We then ranked individual practices using sensitivity analyses, based on their contribution to the performance of the index.

This methodology makes use of retrospective observational honey bee colony loss and management questionnaires, a typical, and relatively low cost, tool in risk factor studies on managed populations. Our methodology allows for complex data that are typical in such surveys (*i.e.* incomplete and semi-structured datasets, with hierarchical relations between questions, resulting in different response rates between questions) and make traditional modelling difficult as these models typically rely on a common set of full answers for all parameters.

This paper describes the step by step process of our new multifactorial analytic method as it applies to honey bee management. By successfully identifying suites of improved beekeeping management practices associated with the highest benefit in reduction of colony mortality risk, we show the utility of this methodology for the complex honey bee system. This strongly suggests that the application of this method to other systems could have significant benefit as well.

Methods

Data Acquisition

a. Survey design

We set out to use part of the dataset that resulted from a series of annual surveys of beekeeper in the USA performed by the Bee Informed Partnership (BIP) to monitor colony losses across the country. The surveys conducted by BIP are of retrospective cross-sectional design in which all respondents all over the country provide, by way of a questionnaire (both online and on paper), a recollection of their management practice for the past year (from April 1 to April 1). We used a sampling scheme of convenience (Dohoo et al., 2003), in which the respondents constitutes a subset of the target population that has come to know of the survey (by direct invitation, advertisement, or word of mouth) and was willing to participate. The intended target population is all US beekeepers, *i.e.* the managed honey bee population in the US. Given the non-availability of a complete list of all sampling units in the source population – in this case, a census of US beekeepers – this second choice sampling scheme was judged the best remaining option, and active and intensive recruitment was deployed to try and limit potential selection bias. Details of the recruitment process and practical implementation can be found in yearly published papers (most recently, Kulhanek et al., 2017).

b. Questionnaire design

The Management Survey was developed and deployed for the first time in April 2011 as an optional supplement to the Loss Survey already organized by BIP in the USA since 2007 (vanEngelsdorp et al., 2007). The Loss Survey was designed to record demographics information at the operation level so as to estimate colony mortality rate over two 6-month periods every year ("Summer", from April 1 to October 1, and "Winter" from October 1 to April 1). In the follow-up Management Survey, information on the participant and its operational management practices over the preceding year were recorded through over 100 questions, from which only a limited number were required. Their answers were recorded in a semi-structured way, combining single choice, multiple choices, and open-ended questions. In addition, the survey was structured hierarchically, with some questions triggered by conditional answers. From year to year, the questions were improved based on comments from the respondents. In particular, for multiple choice questions, proposed answers that were rarely selected in previous year were dropped and newly-proposed answers were added based on frequently appearing themes in the open-entries.

c. Data validation

The database was stripped from identifiable information (names and email addresses replaced with codes). Filters were created to exclude invalidated responses from the analytical dataset without deletion of information. Some responses were edited for processing where appropriate (*e.g.*, replacement of text with numbers – “2” instead of “two”) in copies of the database, while the original answer was kept for archive. Every year, all obvious duplicate answers were manually identified and removed from the analytical database, based on similarity of answers for responses associated with the same IP address or email address. All non-US entries were filtered out, based on the selection of at least one US state from a mandatory multiple choice question. In addition, respondents with insufficient answers to calculate a valid winter loss (between 0 and 100% with a non-zero number of colonies at the start of the season), as well as any obvious typing errors in the report of colony numbers (*e.g.*, non-integer number or exceedingly large (>80,000)) were filtered out of the analytical dataset (following Steinhauer et al., 2014). All other questions were subjected to question-specific validation process, to address issues of non-responses or invalid responses. Missing values were treated differently according to whether the respondent was not asked the question (coded “QNA” Question Not Asked) (*e.g.* a sub-hierarchical question not triggered or a question only appearing in some years of the survey), or whether the respondent truly refused to answer (coded “NULL”). Validity rules were added in the data cleaning phase when data from different years where pooled. If questions were too different to be combined as a single variable, the years in which the question was not applicable were also coded as “QNA”.

All data handling and analyses were performed using R (R versions 3.2.2 (2015-08-14) and 3.4.0 (2017-04-21)- Platform: x86_64-w64-mingw32/x64 (64-bit)) (R Core Team, 2017).

Health outcome: Overwinter Loss estimates

Operational overwintering loss is a rate calculated for every respondent based on the demographic answers for their operation provided in the Loss Survey as the number of colonies lost during a specific period divided by the number of colonies at risk (Steinhauer et al., 2014). To facilitate comparison across years, the operational winter loss was standardized by year.

Population estimates of winter loss for groups of beekeepers were calculated following the standard outlined by (vanEngelsdorp et al., 2013a). Operational losses were then aggregated by 2 different methods ("Total Loss", a weighted average and "Average Loss", an unweighted average) to provide estimates of the population loss (either at national or state level or for any other grouping of respondents based on their typology). Confidence intervals (95% CI) around population estimates were calculated following vanEngelsdorp et al., 2013. Comparisons of winter loss between sub-groups of beekeepers were performed using an analysis of variance with binomial errors accounting for overdispersion (generalized linear model, glm, family quasibinomial from library "stats" (R Core Team, 2017)) and post-hoc Tukey tests (library "multcomp").

Expert-based Management Model

The first objective of this paper is to propose a methodology to summarize complex information about management practices in a simple metric ranging between 0 and 1

– a Management Index – reflecting the quality of the management practices of each respondent compared to an ideal set of practices determined by a panel of experts in the fields of honey bee health and epidemiology (Appendix 5).

The protocol for the construction of the Management Index was inspired by Humblet et al., 2012. It involved using the management information reported for an operation to populate a series of criteria, each representing one unique aspect of beekeeping practices (*e.g*. "source of queen replacement", or "*Varroa* monitoring technique") (see section 1.1.1). Practically, a criteria could encode information from one or more survey questions. For each criteria, the potential answers were grouped and scored by experts (from 0/4 – "worst" option to 4/4 "best" option) (see section 1.1.2) in accordance to their understanding of the associated risk of each option. For example, for the criteria "*Varroa* monitoring technique", the answer "alcohol wash" received a score of 4/4 as the method is deemed highly accurate, whether "visual inspection of adult bees" received a score of 0/4 as this method is known to be unreliable. Next, the criteria scores were weighted based on the experts' opinion on the relative importance of criteria compared to one another (see section 1.1.4). For example, the criteria "source of queen replacement" received a higher weight from the experts than "*Varroa* monitoring technique". Finally, the weighted criteria scores were summed up to compose the Weighted General Management Index (see section 1.1.6).

In a latter phase, we attempted to simplify the Weighted General Management Index, in the same logic as for classical model simplification, until an optimum performance was found. We first compared the performance of the Weighted and Unweighted General Management Indices (see section 1.1.7). We continued on with Simplified

Management Indices (see section 1.1.11), until we reached the Optimal Management Index.

Recruitment of the panel of experts

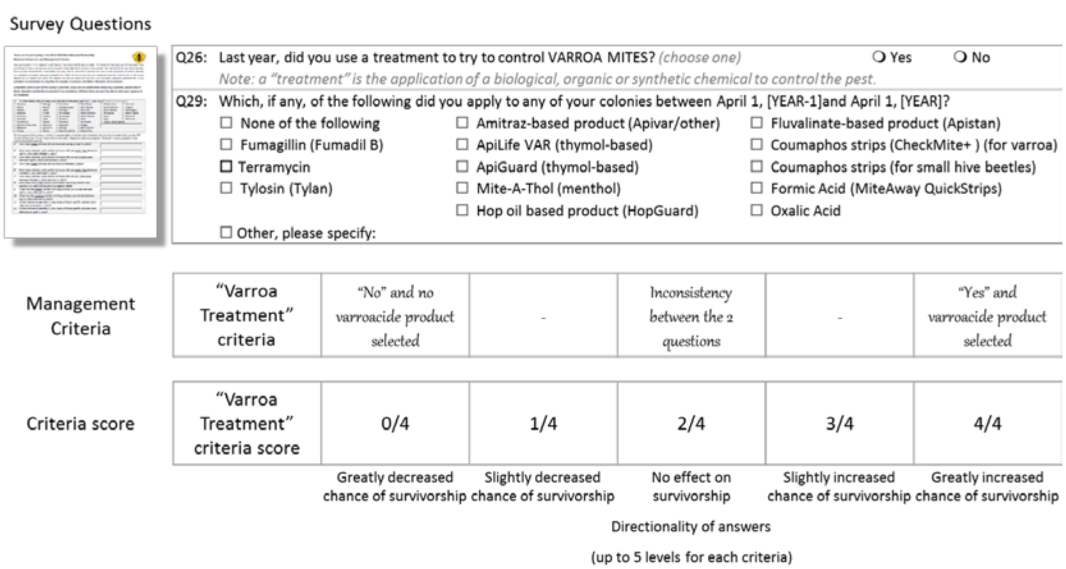
We (the authors) contacted a group of experts in the fields of honey bee health and epidemiology (frequent authors in honey bee research, university professors, extension specialists, industry leaders) from which a subset responded favorably to our request (Appendix 5). Those are the experts who contributed their opinion in terms of conversion of criteria into scores (see section 1.1.2) and relative importance (weights) of criteria (see section 1.1.4).

Summarization of Management Information

1.1.1. Encoding of the management information into criteria

The answers to the 100+ survey questions on operational management practices were condensed and encoded in 82 distinct management criteria (Figure 5. 1 and Appendix 6). One criteria contained information obtained from answers to one or more survey questions. Those criteria were defined because they *a priori* comprehensively captured most aspects of colony management. Practically, the 82 criteria were divided into 8 domains (1. Beekeeper; 2. Equipment; 3. Queens and New Colonies; 4. Seasonal management; 5. Feeding; 6. Monitoring; 7. *Varroa* control strategies; 8. Non-*Varroa* control strategies). Each domain was composed of 3 to 29 criteria.

We then identified the range of potential answers given to each of our criteria from the Management Survey respondents. This was straightforward for criteria compromised of one question and one set of answers. We summarized the possible responses to criteria derived from more than one question so that inconsistent responses could be accounted for. For instance, the criteria "*Varroa* product used" was based on two survey questions: a binary (yes/no) question "*Last year, did you use a treatment to try to control VARROA MITES in your colonies?*" as well as a multiple choice question (multiple selection allowed, with open-ended option) asking respondents to select which product they had applied in their colonies over the preceding year. We identified 3 potential answers: "Yes" with a selection of at least one varroacide, "No" without selection of a varroacide, and two inconsistent combinations: "Yes" without a varroacide being selected (maybe because the respondent didn't remember the name of the product) or "No" with a varroacide selected (maybe because the respondent didn't realize the target of the product used).



<u>Figure 5. 1:</u> Conversion of respondents' answers to the 100+ survey questions into 82 management criteria, with options ordered on a 5 point scale (from 0 to 4 on a maximum of 4).
Example for "Varroa Treatment" criteria, based on 2 survey questions, and for which only 3 of the 5 levels of scoring are specified.

1.1.2. Conversion of criteria options into scores

Once all the answer options for each of the criteria had been identified, we (the authors) assigned each options a score on a 5 point ordinal scale, from 0: "*Greatly decrease chance of survivorship*" to 4: "*Greatly increase chance of survivorship*" on a maximum of 4, based on our understanding of beekeeping and epidemiology (Appendix 6). Our panel of experts was then asked to critically evaluate the grouping and scoring of options for each criteria. Practically, they recorded that they strongly disagreed, disagreed, agreed, or strongly agreed with the assigned scores. If an expert strongly disagreed with a score they were asked to explain their objection and propose an alternative. In cases where there was disagreement among the authors final practice scores for each criteria were decided by the opinion of the majority. Using this grid of scoring, we converted all respondents' management answers into 82 criteria scores ranging from 0/4 to 4/4. To continue the example presented in Figure 5. 1, if the respondent answered "Yes" and selected at least one varroacide product from the list (or in the open-entry), they would receive a score of 4/4 for that criteria. If they answered "No" and did not select any varroacide product, they would receive a score of 0/4 for that criteria. If they provided any other combination of answer, therefore showing an inconsistency, they received a score of 2/4 for that particular criteria.

Missing answers ("NULL") were handled via imputation (see section 1.1.3). Non-applicable questions ("QNAs") did not receive a score (and were not counted in the denominator), meaning those questions did not count against the respondents. The number of criteria actively included in the index therefore varied by respondent (most between 20 and 40). Respondents which provided less than 10 valid answers on the 82 management criteria addressed in this study were filtered out of the analytical dataset.

1.1.3. *Missing scores imputation*

A respondent's criteria score which could not be determined due to missing information ("NULL") received a placeholder value. To determine which placeholder value was most appropriate we compared the results of 4 imputations methods ("zero", "mean", "median", "random"), in which missing criteria scores were replaced by: the lowest score possible for that criteria; the mean score of all valid respondents for that criteria; the median score of all valid respondents for that criteria; or any score at random from the existing levels for that criteria, respectively. Five versions of the General Management Index (without and with imputation for the missing scores) were built and their performance compared (see section 1.1.7).

1.1.4. *Weighting of criteria scores*

In addition to use experts to convert criteria options into scores, we asked them to determine, in their opinion, the relative importance of each practice on colony survivorship. We used this information to assign unequal weights to criteria scores when summing them into the Weighted General Management Index (Figure 5. 2).

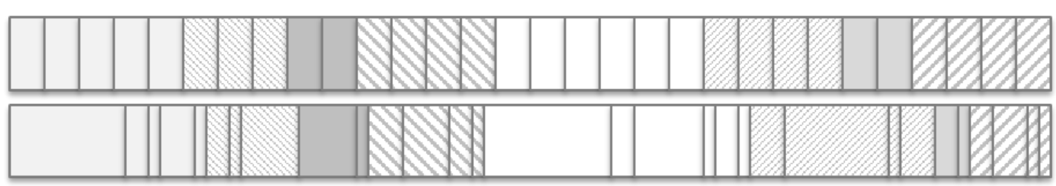


Figure 5. 2: Weighting of the management criteria, grouped in 8 domains, composing the General Management Index.
On the top, all criteria are equally weighted, composing the Unweighted General Management Index. On the bottom, both intra-domains and inter-domains relative

weights (purely illustrative, does not correspond to actual results) determine the contribution of the criteria to the Weighted General Management Index.

We recorded the experts' opinion on relative importance of criteria using the "Las Vegas Technique" (as described in Humblet et al., 2012).

This involved allocating a pre-determined number of "points" between the criteria grouped in each of the 8 domains (CP_i). The number of points available to distribute between criteria within each domain differed to account for differences in the total number of criteria in each. Experts were asked to distribute the assigned points within a domain according to their view of each criteria's importance relative to others. Experts were asked to assign greater points to criteria they thought were going to have greater impact on colony health. The experts were then asked to give relative weights to each domain, by distributing 100 points between the 8 domains (DP_i). Again, we asked the experts to assign more points to domains they considered relatively more important compared to other domains in terms of potential impact on colony health.

We then calculated, for each expert, the relative weight associated with each criteria (W_i, Equation 1) by taking into consideration both the relative importance of the domain the criteria was in (DP_i) and the relative importance of the criteria within that domain (CP_i). Before averaging the opinion of all experts, we re-proportioned that quantity so that the sum of all criteria weights for one expert added up to 1000, to ensure that all experts contributed equally. The experts' opinion were aggregated as the average of W_i across all experts (Appendix 7).

$$W_i = \frac{CP_i * DP_i}{\sum_{j=1}^{n}(CP_j * DP_j)} * 1000 \qquad \text{Equation 1}$$

Equation 1: The relative weight of criteria i (for one expert)(W_i) is the product of the number of points allocated to that criteria inside its domain (CP_i) and the number of points allocated for that domain (DP_i), divided by the total number of points distributed by that expert over all criteria (sum of CP_j*DP_j for all criteria j from 1 to n=82) and re-proportioned to a common 1000 points to allow comparison across experts.

We used the average criteria weight of all contributing experts to modify the criteria scores (original scale of 0 to 4) into weighted criteria scores.

Average domains points (DP_i) and criteria weights (W_i) were subjected to Chi^2 tests to determine any differences compared to an equal distribution, to identify which criteria and domains were perceived by the experts as more important driver of colony success than expected under a null hypothesis.

1.1.5. Criteria exclusion

Before aggregation of the weighted criteria into the General Management Index, we tested the robustness of the individual criteria based on self-imposed standards. We (the authors) imposed a minimum benchmark of 70% response rate among potential respondents (excluding respondents for which the question was not applicable, “QNA”) for a criteria to be included in our model. In addition, we excluded criteria lacking contrasts, based on a ruling of requiring a minimum of 30 respondents in at least 2 option levels. Practically, this resulted in the exclusion of criteria which were unanimous (or very close so) in our sample population.

1.1.6. Aggregating criteria scores into the General Management Index

The weighted criteria scores (S_i*W_i, Equation 2) were summed to compose the Weighted General Management Index. This Weighted General Management Index reflects the assumption of simple additivity of criteria of unequal relative importance (some criteria likely having a higher influence than others, but all contributing independently to mortality risk).

$$GMI = \sum_{i=1}^{n} (S_i * W_i) \qquad \text{Equation 2}$$

Equation 2: The Weighted General Management Index (WGMI) is the weighted (W) sum of criteria scores (S) for all criteria (with i from 1 to n=82), with the criteria weights (W_i) were assigned by experts (see section 1.1.3). The Unweithed GMI represents the particular case of Equation 2 when all weights are equal to 1. Comparisons of index scores between sub-groups of beekeepers were performed using an analysis of variance (aov, from library “stats” (R Core Team, 2017)) and post-hoc Tukey tests.

Management model selection

1.1.7. Selection of Management Index Version

The summarization of management information using experts’ opinion lead us to the construction of 10 versions of the General Management Index, based on a combination of 2 weighting methods (weighted and unweighted criteria scores) and 5 methods of handling missing scores (without and with (4 types of) imputation). We compared their relative performance using simple correlation (Pearson's moment correlation) between the index and the standardized operational Winter Loss.

1.1.8. Management Index Performance

Our working hypothesis was that beekeepers whose management practices are globally more in line with experts' recommendations would experience lower risk of colony mortality. We thereby predicted that higher values of our Management Index, based on expert's opinion, would be associated with lower level of overwinter operational loss. This association was tested through a simple Pearson's product-moment correlation between the Management Index and standardized operational Winter Loss.

In addition to the correlation, the performance of our Management Indices was described through a generalized additive model (gam, library "mgcv") using the standardized operational Winter Loss as response variable and the Management Index as our predictive variable. Gam models have the advantage of not presuming the shape of the relationship between variables, which allowed us to test for potential curvatures in the relationship without a priori information on the shape of the relationship. We also reported the linear regression (lm), when we deemed it conservative estimate of the curvature identified in gam. The impact of covariates, in particular, type of operation and survey year, were investigated using an analysis of covariance.

1.1.9. Sensitivity analyses

After verification of the global performance of our General Management Index, the value of the use of weights and the consistency of different imputation methods, the next step of the analyses was to try to parse out the relative importance of each contributing criteria to the performance of the index. We did so by performing sensitivity analyses and use the resulting ranking of criteria to simplify the index to its optimal structure.

Sensitivity methods aim to decompose the total variance of a model's output into the contributions of each input factor, in our case each weighted criteria score. The simplest of those methods consist of varying "One Factor At a Time" (OAT) and measuring the change in the performance of the new model compared to the baseline model. We adapted this technique to rank our management criteria based on their impact on the relationship between our Management Index and operational Winter Loss.

In practice, we compared the performance of our General Management Index (GMI, Equation 2, combining N criteria), to N simplified Management Index each combining N-1 criteria (SMI). In other words, we ranked criteria based on how sensitive the performance of our Index was to their removal.

The change in the Pearson's moment correlation value ($|cor_{GMI}|-|cor_{SMI}|$) between the Index and operational Winter Loss was used as an indication of the contribution of the criteria to the performance of the index. For example, a criteria which, when removed from the index, did not cause a remarkable change in the correlation value to Winter Loss was ranked low and deemed of low sensitivity, meaning it could be removed without consequence on the performance of the index. On the other hand, a criteria which, when removed from the index, caused a remarkable change in the correlation value to Winter Loss, in that the index was less performant because of its removal, was ranked high and deemed of high sensitivity. OAT methods are only applicable because our index is linear by design and more complex sensitivity methods should be used if applied to non-linear models (*e.g.* those where there is an interaction between management practices).

The ranking resulting from this sensitivity analyze on the unweighted GMI will be compared to the relative weights decided by the experts (using Spearman's rank correlation) to determine if the experts' predictions of relative importance of criteria were supported by empirical evidence.

1.1.10. Bootstrapping

We performed sensitivity analyses in association with bootstrapping as internal validation method to quantify the uncertainty in our ranking of criteria. We used the library (boot)(Canty and Ripley, 2015), with B= 10,000 bootstrap resamples (with replacement from the original sample, or non-parametric method), n-out-of-n method and bootstrap percentile-t method for confidence interval calculations. We opted to use percentile-t over normal CI to better reflect the asymmetry in the distribution of the bootstrap estimates.

1.1.11. Index Simplification

The simplification of the Index was pursued step by step in the inverse order of the ranking of criteria that resulted from the sensitivity analysis, from least sensitive to most sensitive criteria. The performance of the index was measured at each step (see section 1.1.8) and simplification continued until it reached an optimal value – with simpler index structure (with fewest components criteria) being preferred for equally performing indices. The Optimal Management Index (OMI) was identified as the most parsimonious index structure that was best associated with standardized operational Winter Loss.

Comparison across operation types and regions

In order to determine differences in the suites of best improved practices among different types of beekeeping operations, we allocated our respondents in 4 groups, based on a combination of operation size and type or region. Small-scale beekeepers (aka backyard beekeepers, managing less than 50 colonies on October 1st) were divided between those managing colonies in Northern States and those managing colonies in Southern States (based on the demarcations of NOAA's US climate regions (Karl and Koss, 1984), with "North" defined as the grouping of states from "Northwest", "West North Central", "East North Central", "Central", and "Northeast", while "South" was defined as the grouping of states from "West", "Southwest", "South", and "Southeast"). Large-scale beekeepers (aka sideliners and commercials, managing over 50 colonies on October 1st) were divided between single-state and multi-states if they kept colonies in more than one state over the year. The ranking of criteria through bootstrapped sensitivity analyses and the Management Index simplification were performed on the entire data set, and 4 times again using datasets delineated by our beekeeping groupings.

Results

Survey respondents' demographics and Operational Winter Loss

Our analysis utilized 4 years of Loss and Management Survey (2011-12, 2012-13, 2013-14, 2014-15). The four years of surveys gathered a total of 18,971 US-based non duplicated sets of responses that provided sufficient information to calculate a valid operational Winter Loss (0-100%, integers, non-zero colonies at the start of the period) and continued to the Management section of the survey (with a minimum of 10 valid criteria) (Table 5 - 1). The number of respondents ranged from a low of 3,796 in 2011-12 to a maximum of 5,609 in 2013-14. The number of colonies managed by survey respondents represented 8% to 20% of the estimated number of honey producing colonies in the US on any given year (USDA NASS, 2014b, 2015, 2015).

Table 5 - 1: Loss Summary of the respondents of the Management Survey

Operation Size	Regionality	N	Total Colonies on Oct 1st	Total Winter Loss % [95%CI]	Average Winter Loss % [95%CI]
Survey Year 2011-12					
Small-scale	North	2,276	14,006	24.25 [23.17-25.35]	24.03 [22.75-25.32]
	South	1343	8,880	23.28 [21.93-24.67]	23.76 [22.15-25.38]
Large-scale	Single-state	129	87,787	15.31 [12.79-18.08]	21.11 [17.97-24.26]
	Multi-states	48	91,739	19.85 [16.71-23.26]	20.31 [15.93-24.7]
All	All	3,796	202,412	18.45 [17.96-18.95]	23.79 [22.83-24.76]
Survey Year 2012-13					
Small-scale	North	2,850	19,405	45.14 [44.02-46.28]	48 [46.66-49.34]
	South	1690	11,722	37.03 [35.61-38.47]	37.71 [36.02-39.4]
Large-scale	Single-state	196	103,344	25.74 [22.66-28.99]	35.65 [32.02-39.28]
	Multi-states	109	368,029	30.11 [26.99-33.36]	31.63 [27.41-35.86]
All	All	4845	502,500	29.97 [29.42-30.52]	43.54 [42.53-44.55]
Survey Year 2013-14					
Small-scale	North	3,598	21,861	48.56 [47.5-49.62]	49.3 [48.05-50.55]

	South	1763	10,089	29.75 [28.45-31.07]	32.49 [30.86-34.12]
Large-scale	Single-state	142	64,933	27.71 [24.11-31.53]	41.1 [36.52-45.69]
	Multi-states	106	360,474	21.25 [18.63-24.05]	22.35 [18.71-25.98]
All	All	5,609	457,357	23.47 [23-23.95]	43.3 [42.31-44.28]
Survey Year 2014-15					
Small-scale	North	2,906	18,158	43.9 [42.75-45.04]	46.28 [44.94-47.62]
	South	1615	10,051	33.61 [32.21-35.03]	36.01 [34.31-37.72]
Large-scale	Single-state	129	68,230	15.32 [13.04-17.8]	28.59 [24.76-32.41]
	Multi-states	71	234,871	21.33 [17.77-25.2]	28.71 [23.13-34.28]
All	All	4,721	331,310	21.59 [21.07-22.11]	42.02 [40.99-43.05]
All Survey Years					
Small-scale	North	11,630	73,430	41.75 [41.17-42.33]	43.28 [42.6-43.96]
	South	6411	40,742	31.29 [30.59-31.99]	32.93 [32.08-33.77]
Large-scale	Single-state	596	324,294	21.02 [19.45-22.64]	32.27 [30.25-34.29]
	Multi-states	334	1,055,113	24.28 [22.59-26.01]	26.44 [24.15-28.72]
All	All	18,971	1,493,579	24.58 [24.31-24.84]	39.14 [38.62-39.66]

Legend: N= number of respondents/operations. Beekeepers were grouped in types of Operation based on a combination of their operation size (on October 1st) and the US states in which they kept their colonies (over the full year). Total Winter Loss = weighted population average of operational winter loss; Average Winter Loss = unweighted population average of operational winter loss.

Most respondents (95.1%) were characterized as small-scale beekeepers (managing up to 50 colonies on October 1st), the majority of which managed bee colonies in Northern States (61.3% vs 33.8% in Southern States) (Table 5 - 1). However, small-scale beekeepers in our respondent pool managed only a small fraction (7.6%) of the total colonies. Most colonies (92.4%) were managed in large-scale operations (70.6% by beekeepers managing colonies in more than one state vs 21.71% by beekeepers managing colonies in one state only). Small-scale beekeepers typically managed 3 colonies (median number of colonies alive on October 1st). Fifty percent of responding large-scale single-state beekeepers managed around 108 colonies or more, while 50% of large-scale multi-states beekeepers managed 1,175 or more colonies.

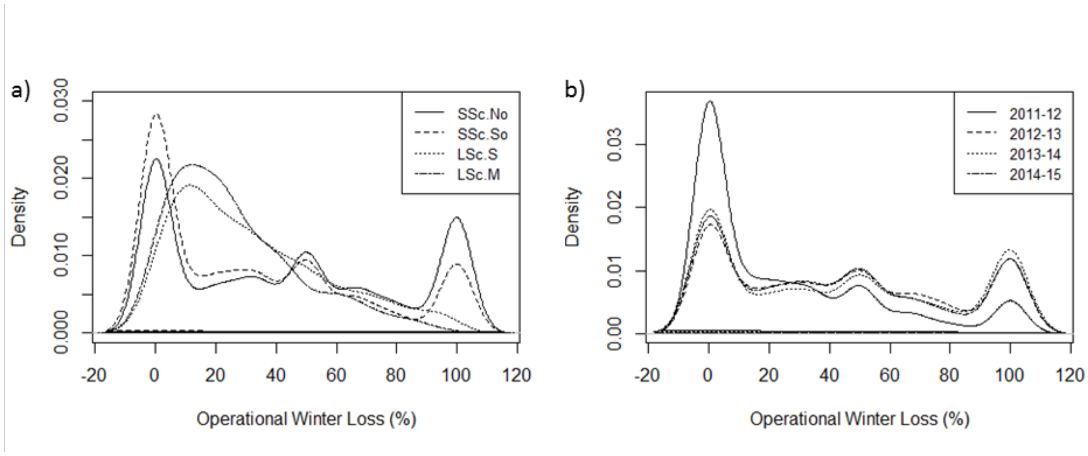


Figure 5. 3: Probability distribution curves of Operational Winter Losses by a) type of operation (all years, n= 18,971); b) survey year (all types of operation, n= 18,971). Legend for operation type: SSc.No= small-scale North, SSc.So= small-scale South, LSc.S= large-scale single-state, LSc.M= large-scale multi-states. Probability distribution was used over frequency distribution to account for the difference in sample size between the sub-groups.

The operational Winter Loss or our participants was extremely variable (see probability distribution in Figure 5. 3a), ranging from 0 to 100% loss across respondents. Both Northern and Southern small-scale beekeepers showed similar distributions of winter losses: tri-modal, with peaks at 0, 50 and 100%, which is typical of a binomial distribution of probabilities when individual respondents have small sample size (*i.e.* a few colonies). Northern small-scale beekeepers were more likely to report 100% loss compared to Southern small-scale beekeepers, and reciprocally at 0% loss. Large-scale beekeepers' operational losses (both single-state and multi-states beekeepers) followed unimodal distributions, with peaks around 12% and a strong right-side skew. At the population level, all years confounded, Total Winter Loss was significantly different between operation types (glm, family=quasibinomial, Likelihood Ratio Test by deletion df=3, F=299.66, $p<0.001$). A post hoc Tukey test indicated that all levels were significantly different from each other, with mortality rates being lowest for large-scale single-state operations (at 21% risk of colony mortality over the winter), followed by multi-states, small-scale operations from the Southern US third and Northern US last (at 42% risk of colony mortality over the winter).

Of the 4 year of survey, three years showed very consistent distribution of Winter Loss (Figure 5. 3b). The survey year 2011-12 appeared as an oddity with a remarkably higher probability of beekeepers to report 0% loss compared to the following years. At the population level, Total Winter Loss was significantly different between survey years (glm, family=quasibinomial, Likelihood Ratio test by deletion df=3, F=327.09, $p<0.001$). A post hoc Tukey test indicated that all levels were significantly different from each other. This encouraged us to standardize winter loss by year in the rest of our analyses.

Expert-based Management Model

Experts' panel

Fourteen experts (background and expertise listed in Appendix 5) contributed to our management model. Eight participated in the encoding of management practices survey answers into criteria scores. All fourteen recorded their opinion on the relative contribution of criteria to chances of colony survivorship, which were used as weight factors in the sum of the criteria scores into the Weighted General Management Index).

Experts' criteria weights

The average number of points distributed among the 8 domains (DP_i) by the 14 experts varied between 6.36 ± 0.9 for "Equipment" and 23.71 ± 2.0 for "*Varroa* Control" (± SE) (Appendix 7). "*Varroa* Control" was the only domain that received more points than under an equal distribution hypothesis (Chi^2=16.932, df=7, p=0.018).

The average criteria weights (W_i) attributed by the 14 experts varied from a low of 3.06 ± 0.53 criteria "Action on Deadouts") to a high of 77.01 ± 14.93 (criteria "*Varroa* Treatment Y/N") (Appendix 7, Figure 5. 4). This distribution was significantly unequal (Chi^2=707.2, df=81, p<0.001), with 10 criteria having received significantly more weight than they would have under an equal weight distribution, and 13 significantly less (marked with * in Figure 5. 4). From those 10 criteria favored by the experts, nine related to the control of *Varroa*.

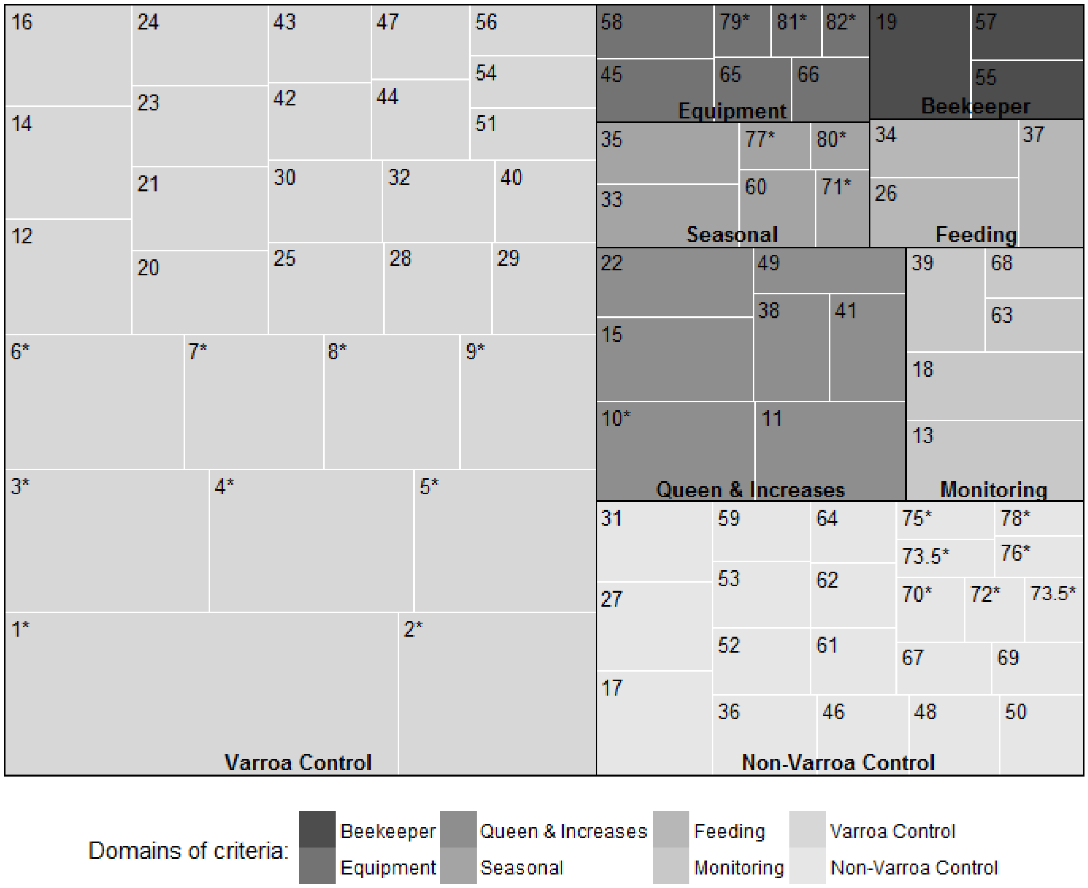


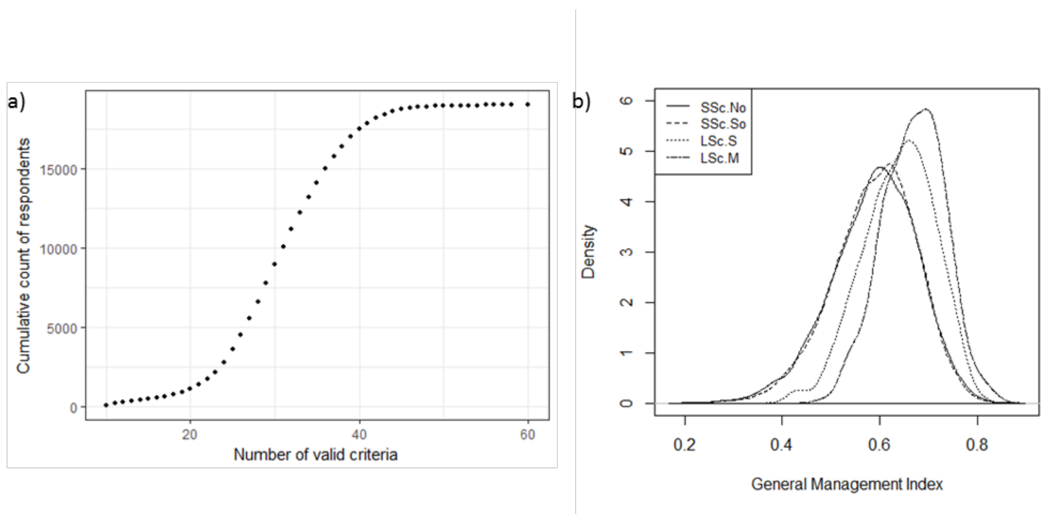
Figure 5. 4: Tree map of the experts' Criteria Weights (CW) of the original set of criteria (n=82) grouped by domains (n=8), ranked from highest to lowest (with ties) (area size proportional to CW value, Appendix 7).
The star (*) indicates criteria which received significantly more or less weight than under an equal-weight distribution (Chi2=707.2, df=81, p<0.001).
Legend (excluded criteria are greyed out):

1*	Varroa Treatment (Y/N)	29	SBB (months)	56	Coumaphos (Varroa) use (count) (excluded)
2*	Varroa Products Applications (count)	30	Coumaphos (Varroa) use (season)	57	Beekeeping Education
3*	Amitraz use (season)	31	Nosema Treatment (Y/N)	58	October Brood Chamber Size
4*	Varroa IPM Practices (count)	32	Fluvalinate use (season)	59	Tylosin use (season)
5*	Varroa Products Type (count)	33	Honey Produced (lbs)	60	Honey harvest (Y/N)
6*	Amitraz use (count)	34	Feeding (season)	61	SHB Trap use (month)
7*	Formic Acid use (season)	35	Crops (count)	62	Fumagilin use (PCol)
8*	Oxalic Acid use (season)	36	SHB Control Technique	63	Nosema Monitoring Technique
9*	Amitraz use (PCol)	37	Feeding Products Type	64	SBH Bait type
10*	Average Queen Age	38	Queen Source	65	Average Comb Age

11	Queens Replaced (Y/N)	39	Varroa Monitoring Technique	66	Comb Culling and Storage Technique
12	Thymol use (season)	40	Contraindications (excluded)	67	Tylosin use (PCol)
13	Varroa Monitoring (Freq)	41	New Colonies Technique	68	Nosema Monitoring (Freq)
14	Formic Acid use (Pcol)	42	Hop Oil use (count) (excluded)	69	SHB Soil Drench use (month&PCol)
15	Queens Replaced (PCol)	43	Fluvalinate use (PCol)	70*	Coumaphos (SHB) use (season) (excluded)
16	Oxalic Acid use (PCol)	44	Drone Removal Amount	71*	Moved across State Lines (PCol) (excluded)
17	FB Treatment (motive) (excluded)	45	Winter Preparation Technique	72*	MiteAThol Use (season)
18	Brood Inspection (Freq)	46	MiteAThol use (motive) (excluded)	73.5*	Coumaphos (SHB) use (count) (excluded)
19	Years of Beekeeping	47	Hop Oil use (PCol)	73.5*	Coumaphos (SHB) use (PCol)
20	Thymol use (Pcol)	48	Nosema Products Applications (count)	75*	MiteAThol use (PCol)
21	Thymol use (count)	49	ReQueening Technique	76*	Nozevit use (season)
22	Started New Cols (Y/N)	50	Terramycin use (PCol)	77*	States (count)
23	Drone Removal (Freq)	51	Powder Sugar use (months)	78*	Nozevit use (PCol)
24	SBB (PCol)	52	Fumagilin use (season)	79*	Foundation type
25	Hop Oil use (season) (excluded)	53	SHB Trap type (excluded)	80*	Moved across state lines (Y/N)
26	Feeding (Y/N)	54	Coumaphos (Varroa) use (PCol)	81*	Equipment Type
27	Terramycin use (season)	55	Sources of information (count)	82*	Action on Deadouts
28	Drone Removal (PCol)				

Encoding of management information into criteria and criteria exclusion

Most respondents provided information that allowed the encoding of 20 to 40 criteria scores (Figure 5. 5a). For each criteria, respondents provided answers to survey questions in 37 to 100% of the time (non-including answers coded QNA). Four of the original 82 criteria failed to reach our benchmark of minimum 70% response rate from potential respondents and were excluded from further analyses (Appendix 7). Another 6 criteria were excluded for missing contrasts by not attaining our benchmark of a minimum of 30 responses in at least 2 levels of the criteria. This left 72 criteria to include in our General Management Index (GMI) (response frequency listed for each criteria in Appendix 7).



<u>Figure 5. 5:</u> a) Cumulative frequency distribution of the number of valid criteria scores used to calculate the General Management Index for each valid respondent; b) probability density distribution of the General Management Index by type of operation (all years, n= 18,971 respondents).
Legend for operation type: SSc.No= small-scale North, SSc.So= small-scale South, LSc.S= large-scale single-state, LSc.M= large-scale multi-states.

The unweighted General Management Index (GMI) score for all responding beekeepers ranged from 0.20 to 0.86, with an average of 0.59, and an asymmetric distribution skewing towards lower GMI scores (Figure 5. 5b). Unweighted GMI scores differed significantly across operation types (aov, test by deletion, df=3, Sum of Sq=3.4523, $p<0.001$), with large-scale multi-states beekeepers scoring significantly higher than large-scale single-state beekeepers, themselves ahead of small-scale beekeepers from both regions.

Management model selection

Each of the 10 versions of the General Management Index was significantly negatively associated to operational Winter Loss standardized by year (Table 5 - 2), meaning that operations which reached a high GMI score also reported a lower level of colony mortality over the winter, irrespective of the imputation and weighting method used.

The various imputations methods represented a marginal improvement on the non-imputed GMI, with the exception of the "minimum imputation" method (overlapping 95% CI). We decided to proceed with the overall most performant method of imputation ("mean" imputation method).

The use of criteria weights (W_i) in the construction of the GMI did not seem to result in a systematic improved performance of the index in comparison to unweighted GMI (all correlation estimates 95% CI overlapping). We decided to proceed with the most parsimonious method of index construction based on equally weighted criteria scores.

Our method for the summarization of management information according to expert's opinion lead us to the construction of a General Management Index (GMI) significantly associated with a reduced risk of overwinter colony mortality (Table 5 - 2), with the selected most parsimonious version combining the "mean" imputation method and unweighted criteria scores additivity (all results displayed here-after were obtained from this GMI version).

Table 5 - 2: Relative performance of 10 versions of the General Management Index (regarding criteria weightings and imputation) as tested by GMI's association to the operational standardized Winter Loss.

		Pearson's product-moment correlation (df=18,969, all p-values < 0.0001)	
Imputation	**Weight**	**t**	**Cor r [95% CI]**
none	Unweighted	-17.213	-0.124 [-0.138, -0.11]
none	Weighted	-19.888	-0.143 [-0.157, -0.129]
minimum	Unweighted	-17.436	-0.126 [-0.14, -0.112]
minimum	Weighted	-19.918	-0.143 [-0.157, -0.129]
mean	Unweighted	-21.408	-0.154 [-0.168, -0.14]
mean	Weighted	-20.503	-0.147 [-0.161, -0.133]
random	Unweighted	-20.839	-0.15 [-0.164, -0.136]
random	Weighted	-20.472	-0.147 [-0.161, -0.133]
median	Unweighted	-21.347	-0.153 [-0.167, -0.139]
median	Weighted	-20.506	-0.147 [-0.161, -0.133]

General Management Index performance

When tested through generalized additive modeling (gam), the GMI presented strong evidence of curvature in its relationship to standardized Winter Loss (gam, Y=s(X), edf=2.87, F=134.3, p<0.001) (Figure 5. 6a, black smooth line). The shape of the curve indicated a potential threshold (around an index score of 0.5) under which management quality is not clearly associated to risk of overwintering mortality, followed by a stronger association for the median to high levels of the GMI scores. The linear regression appears as a conservative estimate of the slope of the relationship above that threshold, which correspond to the majority (75%) of our respondents. Assuming a linear relationship in this section of the curve, the GMI score was significantly associated to a reduction in standardized Winter Loss (lm, $Y=1.04 - 1.76X$, F=458.3, df=1, p<0.001) (Figure 5. 6a, blue regression line). This means that, for the majority of beekeepers (with indices ≥ 0.5), beekeepers reporting management practices closer to the ideal set by our experts (with higher GMI scores) were at lower risk of overwinter colony mortalities, when compared to the average level of loss that year. Given the slope of this relationship, we can expect that for each improvement of 0.1 in the GMI score, an operation would reduce its risk of overwintering colony loss by 0.176 standard deviation, which represent a reduction of between 5.3 and 6.6 percentage points between the years of our survey.

Both survey year and operation type were significant covariates of GMI in its relation to standardized Winter Loss (lm, test by deletion of 2-way interaction between index and operation type: F=7.0422,df=3,p<0.001 ; test by deletion of 2-way interaction between operation type and survey year: F=11.572,df=9, p<0.001), but not as a third level interaction (lm, test by deletion of 3-way interaction between index, operation type and survey year: F=0.590, df=9, p=0.807). In other words, the relationship between the general management index scores and standardized winter loss rates of different operation types were best modelled with relations that had different slopes, but that those slopes were consistent across years (also confirmed in gam, Figure 5. 6b,c).

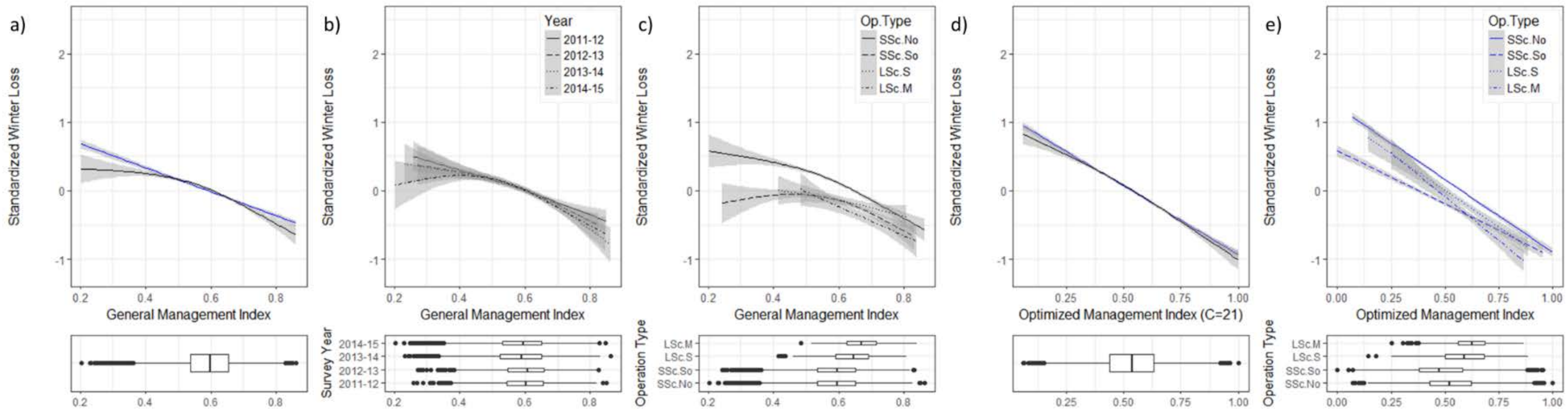


Figure 5. 6: Performance of the General Management Index model (a, b, c,) and the Optimized Management Index model (d): a) smoother estimate (gam) and 95% confidence intervals (in black) and linear correlation (in blue) of the Standardized Winter Loss by the General Management Index (N=72 criteria), across all respondents; b) gam, by survey year; c) gam, by type of operation; d) gam (black) and linear correlation (blue) of the Optimized Index (N=21 criteria) across all respondents; e) linear correlation of the Optimized Indices by operation type (N=16, 9, 15, 25 criteria respectively). Legend for operation type: SSc.No= small-scale North, SSc.So= small-scale South, LSc.S= large-scale single-state, LSc.M= large-scale multi-states.

Ranking of criteria through sensitivity analyses

Over all respondents (Figure 5. 7a), the bootstrapped sensitivity analyses identified a small number of criteria that consistently (with small 95% CI) ranked highly, indicating these were important for the performance of our Management Index model. The bulk of the criteria had large confidence intervals, indicating their ranking was dependent on the random bootstrap resamples of beekeepers. A final cluster of criteria also displayed narrow confidence intervals, indicating that they consistently ranked low for all bootstrap resamples of beekeepers.

The profile of the ranking of criteria varied between the 4 subgroups of beekeepers by type of operation. Both small-scale groups (north and south) displayed a similar 3 tier structure of a small number of consistently high ranking criteria, small number of consistently low ranking criteria, and largely variable majority of criteria ranking somewhere in the middle (Figure 5. 7b,c). Large-scale beekeepers (Figure 5. 7d,e) presented a less structured ranking profile, which larger 95% CI, indicative of higher variability of the criteria's ranking between the bootstrap resamples, which can be partially explained by the smaller sample size of those 2 groups.

The overall ranking (all participants combined) was significantly correlated to all 4 of the rankings by type of operation (Spearman's rank correlation, S-values between 10542 and 31890, p-values <0.05, rho between 0.49 and 0.83). The subsets with the ranking most comparable to the overall ranking were the 2 small-scale subsets, which can be expected as they represent the most frequent types of beekeepers in our population.

The rankings of criteria between the 4 subsets of beekeepers were largely correlated (Spearman's rank correlation, S-values between 26246 and 44428, p-values <0.05, rho between 0.28 and 0.58), with the most comparable being the two groups of large-scale beekeepers compared to each other, and the two groups of small-scale beekeepers compared to each other.

The ranking of criteria by sensitivity analyses on the performance on the General Management Index was noticeably different than the ranking assigned by experts (based on the relative criteria weights W_i) (Spearman's rank correlation, S=62012, p-value=0.9804, rho=0.002)(Appendix 3, CW Rank and Appendix 4, rank). The same was true when the expert's ranking was compared to any of the sensitivity ranking based on the 4 subsets of beekeepers by operation type (Spearman's rank correlation, S between 54260 and 64736, p-values between 0.28 and 0.73, rho between -0.04 and 0.13).

Management Index simplification

Using the sensitivity ranking of criteria as guiding order, we proceeded to simplify the General Management Index step by step, and observe the change in the model's performance (Figure 5. 7f, test p-values for the correlation at each step of the simplification process between the Management Index and standardized operational winter loss). Over all respondents, the correlation was optimized for the index composed of the 21 most sensitive criteria (OMI Optimized Management Index). The Optimized Management Index (OMI) (Figure 5. 6d) performed not only as well as the General Management Index despite its simpler structure, but even better: the correlation value was higher and the relationship more linear all throughout the range of index scores. Though OMI still presented evidence of curvature in its relationship to standardized Winter Loss (gam, $Y=s(X)$, edf=2.30, $F=4.6703$, $p=0.0099$) (Figure 5. 6d, black smooth line), the linear relationship can be considered a good and conservative approximation of the relationship for all but the extreme values of the index. Assuming a linear relationship, the Optimized Management Index for all respondents, all years, was significantly negatively associated to the standardized Winter Loss (lm, $Y=1.07 - 2.01X$, $F=1489$, df=1, $p<0.001$) (Figure 5. 6d, blue regression line). This indicates that any improvement of 0.1 in the OMI score would reduce the risk of overwintering colony loss by 0.20 standard deviation, which represent a reduction in risk of between 6.1 and 7.6 percentage points between the years of our survey. More importantly, the recommendations of improved management practice that would drive this reduction in risk have been reduced to 21. Those 21 management criteria belonged to 5 different domains, though the most represented was "*Varroa* Control" (with 10 criteria out of 21). As said previously, the sensitivity ranking of the criteria did not correspond to the ranking from the experts based on weights. While 5 of the top 10 criteria having received the largest weights by the experts (more than under the null hypothesis) were part of the Optimized Management Index, two of the most sensitive criteria composing OMI were not considered important according to the experts ("Action on deadout" and "States (count)", Appendices 3 and 5).

In a similar fashion as for the GMI, both survey year and operation type were significant covariates of the OMI (lm, test by deletion of 2-way interaction between index and operation type: $F=2,7991$,df=3,$p=0.0385$; test by deletion of 2-way interaction between operation type and survey year: F=13.107,df=9, p<0.001), but not as a third level interaction (lm, test by deletion of 3-way interaction between index, operation type and survey year: F=0.3784, df=9, p=0.3784). This is another indication that the Management Index performs differently according to the type of operation.

Table 5 - 3: Effect size of an improvement of 0.1 in the Optimized Management Index (OMI) by beekeeper group. The change in standard deviation of operational winter loss has been converted in percentage points and compared to the average operational Winter Loss experienced (Obs. Av WL) by the specific group of beekeeper for that year. The adjusted average Winter Loss represents the risk of colony mortality an operation would have experienced if they had improved their practices by 0.1.

			Effect size: for each improvement of Index by 0.1				
Beekeeper typology		OMI n criteria	Δ WL StdDev		Δ WL (%)	Obs. Av WL (%)	Adj. Av WL (%)
Small-scale	Northern	16	-0.212	2011-12	-6.647	24.03	17.39
				2012-13	-7.762	48.00	40.24
				2013-14	-8.122	49.30	41.18
				2014-15	-7.821	46.28	38.46
Small-scale	Southern	9	-0.154	2011-12	-4.654	23.76	19.11
				2012-13	-5.473	37.71	32.23
				2013-14	-5.402	32.49	27.09
				2014-15	-5.408	36.01	30.61
Large-scale	Single-state	15	-0.215	2011-12	-3.913	21.11	17.20
				2012-13	-5.570	35.65	30.08
				2013-14	-5.989	41.10	35.11
				2014-15	-4.757	28.59	23.83
Large-scale	Multi-states	25	-0.255	2011-12	-3.945	20.31	16.37
				2012-13	-5.727	31.63	25.91
				2013-14	-4.861	22.35	17.49
				2014-15	-6.104	28.71	22.61

The same simplification process was performed for each of the subsets of beekeepers according to operation type. The optimization curve were generally similar for all 4 groups of beekeepers; however, the number of criteria included in the Optimized Management Index varied for each of them, ranging from a low of 9 criteria for small-scale southern beekeepers to a high of 25 criteria for large-scale multi-states beekeepers (Appendix 5, criteria marked by *). The slopes of those various indices was variable, but the effect sizes were comprised between a reduction of 3.9 and 8.1 percentage point for every improvement of 0.1 in the index (Table 5 - 3), according to the beekeeper's typology.

All 21 criteria that were included in the Optimized Management Index for all participants were present in at least one of the OMI developed for each beekeeping subgroup. One or more of these optimized indices also included an additional 15 criteria (Appendix 5). All told, 36 criteria appeared in at least one of our OMI. Two criteria were retained in all 4 subset-specific Optimized Management Indices: "New Colonies Technique" and "Crops (count)". Another 7 were retained in 3 of the 4 subsets: "Action on Deadouts", "*Varroa* Treatment (Y/N)", "Comb Culling and Storage Technique", "*Varroa* Products Type (count)", "Honey produced (lbs)", "Average Comb Age", "Screened Bottom Board (PCol)". Nine criteria were retained in any 2 subsets and the last 18 criteria were retained in only one of the 4 subsets of beekeepers.

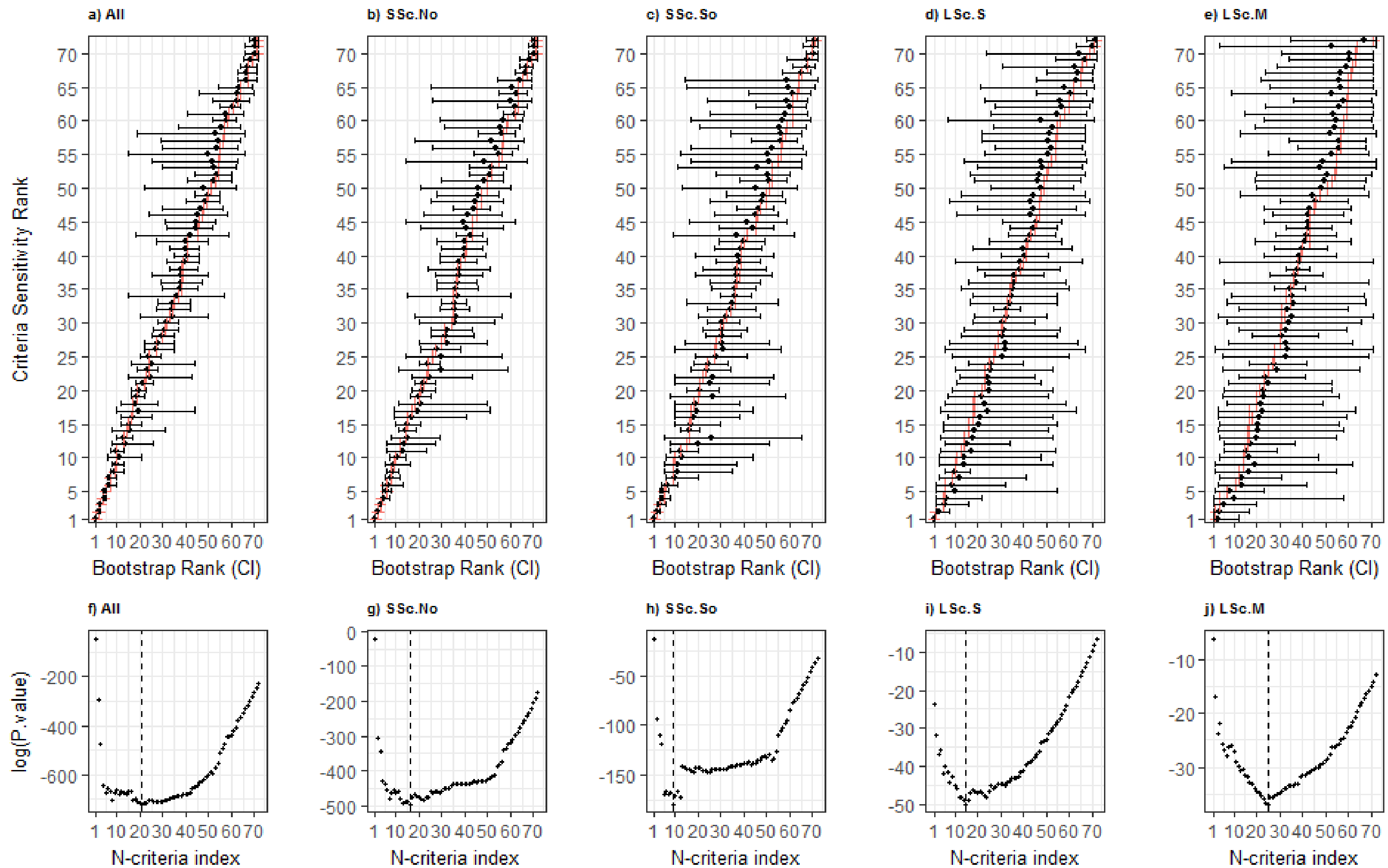


Figure 5. 7: Sensitivity Analyses on the General Management Index: a-e) bootstrap estimates of the rank (mean estimates of b=10,000 bootstraps with 95%CI based on percentile distribution, bootstrap median indicated in red plus sign) compared to original ranking (for a) all participants and b-e) subsets by operation type). f-j) optimum index performance curve: p-value of Pearson correlation of the index (at various stages of simplification) to standardized Winter Loss, by increasing

number of criteria in the indices (from N=1,single criteria, to N=72,General Management Index). Vertical dash bar indicates optimum.

Legend: All = all beekeepers included, SSc.No= small-scale North, SSc.So= small-scale South, LSc.S= large-scale single-state, LSc.M= large-scale multi-states. See criteria name in Appendix 5, by sensitivity rank.

Discussion

Honey bee colonies are facing a wide array of stressors, from pests and pathogens, to nutritional deficiencies and pesticide contaminations, acting singularly or in combination (Goulson et al., 2015b; Pirk et al., 2016; Potts et al., 2010a; vanEngelsdorp and Meixner, 2010). Management practices have the potential to buffer or exacerbate some of those drivers and ultimately impact colony mortality. In this project, we developed a technique to identify key management practices with the highest potential for reducing colony mortality risk for specific groups of US beekeepers, using real world survey results.

Management practices englobes a wide array of variables each presenting multitude of factor levels, which makes them unconducive to experimentation in a comprehensive view. In addition, when experimental data is collected, results are difficult to generalize to larger scale settings. By contrast, management practices are an ideal target of observational studies which capitalize on natural events to test wider arrays of hypotheses than experimental designs and at a lesser cost (K. Lee et al., 2015). This in turn might help develop streamlined lines of inquiry to further explore through experimental studies. Most importantly, observational studies can guide disease intervention methods and measure the efficiency of control and prevention methods in real world situations, where experimental studies always present some form of simplification.

Various aspects of management have been associated to colony health outcomes in contingence to a particular health stressor. For example, nutritional supplementation can partially compensate nutritional deficits in periods of dearth (Brodschneider and

Crailsheim, 2010), though a natural mix of pollen remains the optimal source of nutrients for bees (Decourtye et al., 2010). Most notably, given the high impact of *Varroa*, it is believed most colonies in temperate climates would collapse within 2 to 3 years without periodic treatments (Rosenkranz et al., 2010). Several practices have been identified as risk factors of either high *Varroa* levels, or treatment efficacy (Giacobino et al., 2015b, 2016a). This is the first study in which a comprehensive set of management practices have been investigated simultaneously to determine their relative importance in terms of potential gains in reducing risk of colony mortality. This is also the first study to attempt to quantify the impact of management practices on colony mortality in a holistic way.

Survey respondents and Operational Loss

During the four iterations of the survey (from 2011 to 2014), 18,971 responses were collected, for an average of over 4,700 respondents per year. Those respondents managed between 202,000 and 502,000 colonies (Table 5 - 1, Total colonies on October 1st), which represents, depending on the year, between 8 and 20% of the nation's estimated number of colonies. To our knowledge, this is the largest survey focusing on honey bee demographics and management practices, in the US and abroad.

As the survey is meant to maintain anonymity (contact emails are only provided on a voluntary basis), it is hard to determine the proportion of beekeepers who participated in more than one year of the survey. According to the experience of BIP personnel, the possibility exists, probably more so for large-scale beekeepers, but is probably limited in regards to small-scale beekeepers. In this study, we considered different years of the survey as independent pools of respondents.

The demographic structure of our respondent pool, in which the majority of colonies are owned by a minority of the beekeepers, is characteristic of the beekeeping industry in the US. In their first report on honey bee colonies, USDA NASS numbers 98.32% of the colonies to be managed in operation of 5 or more colonies (2,874,760 compared to 49,000 managed in operations of less than 5 colonies, on October 1st, 2015, (USDA NASS, 2016)). With 1,468,530 colonies grouped in operations of 5 or more, and 25,049 colonies in operations of less than 5, our survey participants seem representative of this ratio (Chi^2 = 0.0077642, df = 1, p-value = 0.9298).

Operational winter loss was highly variable (Figure 5. 3). The distribution of small-scale beekeepers' operational winter loss was trimodal, with peaks at 0%, 50% and 100% loss. This is consistent with a binomial distribution with relatively small number of trials (each beekeeper managing a small number of colonies). Professional beekeepers (both single-state and multi-states) displayed a unimodal distribution of their operational loss, still spanning the full range of value, with similar right-end tailing.

Our population estimates (Total Loss) varied significantly by year and type of operation (Figure 5. 3ab). Large-scale beekeepers experienced lower levels of loss than small-scale beekeepers. Small-scale northern beekeepers losing a higher percentage of colonies over the winter than southern small-scale, followed by professional multi-states and finally professional single-state experiencing the lowest levels of loss. The grouping of single-state vs multi-states represents the best estimate of migratory beekeeping, under the definition that migratory designates beekeepers moving at least part of their operation across state lines at least once in the year.

Our respondents represent a subset from the US National Loss Survey, published annually by BIP (latest results in Kulhanek et al., 2017), as the Management Survey is a voluntary follow up to the Loss Survey. Professional beekeepers (both single-state and multi-states) were more likely to continue to the Management Survey than small-scale beekeepers (of both region) (Chi^2=18.7, df=3, p-value=0.0003), which could explain the slightly lower Total Winter Loss of our aggregated participants than that reported from the Loss Surveys. This might indicate a potential bias that beekeepers who reported their management practices in the Management Survey performed overall slightly better than the average beekeeper, either because more successful beekeepers would be more likely to remember or report their practices. This could also be explained by the format of the questionnaire, as professional beekeepers were mostly targeted by paper surveys in which the transition from Loss survey to Management survey is less obvious, therefore making them more likely to complete both surveys.

Experts' panel

Fourteen experts provided their opinion to our scoring system, in two consecutive steps: the encoding of management practices and their specific options into criteria scores and the assignment of relative weights to the resulting criteria. The experts all have a strong experience in the fields of beekeeping, bee health or epidemiology. They are also representatives of all sides of the community: university researchers, field consultants, beekeepers and private companies. Each expert's opinion was recorded individually from the others.

As lessons learned for future applications of this method, we would recommend to try keeping management criteria general, and use options inside criteria levels to deep into specifics. For example, we set the use of specific products as criteria (one criteria per product), with the different options being the correct or incorrect use of the product (timing and other application instructions), but experts tended to confuse their agreement to the product's application methods with their confidence in the efficacy of the product itself. If this study was to be repeated, we would set a criteria on which product was chosen, with options ranking between products based on their a priori efficacy, and then a general criteria on product application to assess if the method of application (timing or other) were appropriate, no matter which product was chosen.

Experts' criteria weights

When asked about their opinion on the relative importance of domains and criteria, the experts clearly favored management criteria relating to the control of *Varroa* (Figure 5. 4). Among the 8 domains of criteria, the experts considered the domain of "*Varroa* Control" as having the greatest importance relative to other domains effect on impacting over wintering success. Among the 10 criteria which received significantly more weight than under an equal weight distribution, nine related to the control of *Varroa*. The 13 criteria that received significantly less weight than under an equal weight assumption belonged to the domains "Equipment", "Seasonal management" and "Non-*Varroa* control" (specifically relating to the use of 3 products for the control of small-hive beetles, Nosema and tracheal mites). This clearly indicates the importance experts put on *Varroa* management issues.

Encoding of management information into criteria and criteria exclusion

The variability in response rate between survey questions (and therefore, management criteria) was partly due to the hierarchical structure of the questionnaire, with not all questions relevant to all respondents. Imputation was used to deal with missing answers, but not with "non-applicable" questions. This made traditional statistical modelling, such a generalized linear models, impracticable as they rely on complete observation lines. The summarization in an index in which not-applicable questions did not count against the respondent allowed us to propose a consistent characterization of the management of beekeepers.

The unweighted General Management Index varied from 0.20 to 0.86, on a theoretical maximum of 1 (Figure 5. 5b). This suggests that the index expressed a wide range of quality of management with which to test the association to overwintering success. It also reflected the potential for improvement in terms of management practices, as most beekeepers were not up to the maximum limit of the index. A distribution with a peak close to the maximum of the index would have indicated a small to absent room for improvement, and possibly a set of experts' recommendations too self-evident and largely already applied by the stakeholders' population. In all years of the survey, professional beekeepers displayed higher indices than small-scale beekeepers (Figure 5. 5b), meaning their management practices were more in alignment with the recommendations of the experts.

Selection of the imputation and weighting method

Independent of the use of imputation method and variable weighting of criteria, all versions of the General Management Index were significantly negatively associated to operational Winter Loss, standardized by year (Table 5 - 2). The correlation values varied between -0.124 (for the unweighted non imputed data) to -0.154 (unweighted mean imputed data). All 95% CI of the correlation estimates excluded the value of the null hypothesis. Before optimization, our crude estimate of the quality of management practices was highly significantly, though weakly, associated with the risk of colony mortality.

Imputation represented a marginal improvement over non-imputed data, as measured by a Pearson's product-moment correlation to the standardized Winter Loss of respondents (Table 5 - 2). We decided to proceed with the overall most performant (mean) method of imputation. The effect of weighing was inconsistent, with no general improvement of the performance of the index compared to the unweighted versions (Table 5 - 2). It is possible that the lack of impact of the expertise-based vector of weight was due to the relative low disparities between criteria weights (CW_i), as experts mostly promoted a few factors ahead of a cohort of similarly-low-weight criteria. We would recommend that future uses of this methodology insisted on expert's stronger discriminations between criteria. Because of the lack of evidence of the better performance of the weighted index, we proceeded with the simpler hypothesis of simple additivity of criteria (equally-weighted criteria composing the index).

General Management Index performance

There was strong evidence of a curvature in this relationship (Figure 5. 6a, gam), indicating that the benefit of improved management practices would be stronger after a minimum threshold. It essentially means that for very low scores of the index – with management practices far from the experts' recommendations – a lot of improvement is required before seeing a reduction in mortality risk. On the other hand, beekeepers starting with a medium index (which correspond to the 75% percentile of the population of our respondents) can expect a sharper reduction in risk with a small improvement in practices. The linear regression appears as a conservative estimate of the slope of the gam smooth for those median to high index respondents. Assuming a linear effect in that section of the relationship, it would indicate that any improvement of 0.1 in the management index would be associated with a reduction in the risk of overwintering colony loss of 0.176 standard deviation. This represents a reduction of between 5.3 and 6.6 percentage point between the years of our survey, which is not trivial for a beekeeping operation.

Both survey year and operation types were significant interacting covariates in the relationship between the index and standardized winter loss. The interaction between operation type and survey year was expected as it had already been shown that the directionality of the effect of operation type on winter loss varied by year. The interaction between the index and operation type indicates that the slope of the relationship is dependent on the type of operation. The absence of a third level interaction between the index, operation type and survey year reassured us that the slope of the index was consistent across years for a specific type of operation (Figure 5. 6bc).

Our methodology successfully summarized the quality of a wide array of management practices according to the opinion of experts in a simple index associated with the risk of overwintering colony mortality. Our General Management Index, composed of 72 equally weighted criteria, is significantly associated to a reduction in Winter Loss, standardized by year (Figure 5. 6). This means that beekeepers who reported management practices of higher quality, according to the opinion of experts, were more likely to report lower mortality rates of colonies over the winter. The steepness of the decline in mortality risk associated with an improvement in management practice varied by operation type, but in a manner that was consistent throughout the survey years, meaning that even though the level of loss varied from year to year (and by operation type), the performance of the index was consistent in all circumstances.

This is the first study to report an association between quality of management practices assessed as a whole and colony loss. Previous research have addressed various aspects of management one at a time, mostly concerning pest control or feeding supplementation, but none have considered management in a comprehensive way. Though this study does not imply a cause to effect, this result suggest that management practices can indeed affect the success of beekeeping operations, by mitigating or intensifying the risk of colony mortality. The relatively low effect size of this relationship reminds us that, though management is one of the most actionable colony health risk factor for beekeepers, it is not the only stressor affection honey bees. Though improving management practice is associated with a reduction in risk of colony mortality, the effect of this decrease in risk is constrained by other factors affecting bee health.

Our results can also be taken as a validation of the opinion of experts, as the directionality of the criteria was based on their judgment. It should be noted that this validation of expert's opinion is global, but not punctual (criteria by criteria). A possible further study should test the influence of permutations of the criteria's levels to identify the optimal options for each criteria and confront those data-based optimums to the opinion of experts. As this could be computationally intensive, the use of Augmented Intelligence might be appropriate.

Ranking of criteria through sensitivity analyses

Our research not only reveals a significant relationship – better management (according to experts) associated with reduced risk of colony loss – but also allows the prioritization of criteria according to the sensitivity of winter loss to their presence in the index. In other words, we ranked criteria based on which behavioral change would be associated with the largest reduction in risk of colony loss.

When performed over all respondents, the bootstrapped sensitivity analysis revealed a ranking of the management criteria clustered in 3 levels: a very consistent set of top management practices followed by a wide array of interchangeable criteria whose rank – though always mediocre – is highly dependent of the subset of respondent selected by the bootstrap, and finally tailed by a small set of criteria consistently ranked last across all bootstrap samples (Appendix 8 and Figure 5. 7a). Because the ranking is based on the sensitivity of the performance of the index, it can be understood as the relative importance of the specific criteria in ensuring the correlation between the index and the operational loss.

We interpret the high ranking cluster in this 3 tier structure as management criteria which present a high potential for the reduction in the risk of overwintering colony loss. The narrow bootstrap CI of those criteria indicates that their top ranking is very consistent across our whole respondents' population. On the other hand, the lowest ranking cluster can be seen as management criteria representing the lowest potential for improvement of colony loss, which could potentially be due to either a low impact of the criteria (no difference in success between the various options for that criteria) or a high prevalence of the "best" behavior already established in the population.

This 3 tier structure of the criteria ranks hold true for both small-scale subsets of beekeepers: the profile and rankings from northern and southern small-scale beekeepers were very similar to the original ranking (Appendix 8, Figure 5. 7bc), which was expected as they represent a majority of the survey respondents.

Large-scale beekeepers obtained visually different profiles and rankings, which clearly illustrates the need to consider operation types separately when prioritizing management practices. Large-scale beekeepers presented rankings that were more variables according to the random subsets of respondents considered (Figure 5. 7de). This indicates that if "top recommendations" can be easily picked out for small-scale beekeepers, such generalization is harder for large-scale beekeepers. Large-scale beekeepers started with a higher average index score than small-scale beekeepers, indicating how large-scale beekeepers' practices were generally more aligned with experts' recommendations than small-scale beekeepers. Our analysis indicates that criteria holding the most potential for improvement for large-scale beekeepers are more variable, highlighting the need for specialists consultant working at a more individual level.

Finally, the ranking of the criteria, at the whole population or subgroup levels, were noticeably different from the relative weights assigned by the experts and representing their opinion of the relative importance of criteria in regards to colony mortality risk. Experts were asked to weight criteria based on their understanding of the most influential criteria on overwintering loss prospects, but without taking into account a potential for improvement that is included in our ranking. This discrepancy illustrate that extension messaging would be most efficient if they were based on potential for improvement of risk, which experts' are not adept at predicting.

Management Index simplification

The performance of the Management Index, over all respondents, reached an optimum at 21 components' criteria (Figure 5. 7f). A linear relationship was deemed a good estimation of the relationship of the Optimized Management Index (OMI) to the standardized Winter Loss and would predict a reduction of 0.20 standard deviation in the risk of overwintering colony loss for each 0.1 improvement in the management index, which represents between 6.1 and 7.6 percentage point of winter loss depending on the survey year. The performance of the OMI was superior to the GMI, with a more manageable set of criteria. The investigation of the relationship for curvature also indicated a less marked threshold effect, which might be explained by the successful removal of the “noise” of management criteria for which a behavior change was not associated with reduction in risk.

For the most part, the criteria composing the OMI did not correspond to the criteria favored by the experts. This would mean that experts were successful at identifying the “best” from the “worst” options for each particular management criteria (as verified by the good performance of the indices), but not at prioritizing between criteria as to which behavior change would be most rewarding for the beekeepers. Two criteria were particularly misjudged by the experts: “Action on deadouts” and “States (count)” both received less weight from the experts than they would have under an equal weight distribution, but were high ranking in the sensitivity analysis and therefore retained in the OMI.

The 21 criteria composing the OMI ranged 5 domains of management criteria (Equipment, Queens and New Colonies, Seasonal management, *Varroa* Control strategies and Non-*Varroa* Control strategies). The only domains completely removed from the Simplified Management Index were “Feeding” and “Monitoring”, though some of those practices were included in operation-type specific indices.

Comparison of OMI performance across operation types and regions

The simplification of the index led us to choose a different selection, and number of component criteria in the Simplified Indices of the different subsets. The OMI of the southern small-scale beekeepers was the simplest index, with 9 criteria (Figure 5. 7g), while the most complex was composed of 25 criteria for multi-states large-scale beekeepers (Figure 5. 7j). Again, the effect size of this association was low, but highly significant, with realistic and non-trivial reductions in risks of colony mortality.

All 21 criteria from the all respondents-OMI were retained in one or the other of the subset-specific OMI, with an additional 15 criteria that were not initially retained in the index composed at the whole population level. Only a couple of criteria were retained in all 4 subset-specific OMI, and only a few more in most (3 out of 4) of the subsets, illustrating the difficulty to provide relevant general management recommendations when addressing the diverse beekeeping community.

For example, the criteria "*Varroa* Treatment (Y/N)", a simple 3 level criteria addressing the use (or not) of a chemical product for the control of *Varroa*, ranked highly in all subsets of beekeepers but large-scale multi-states. This apparent contradiction can be explained by looking at the answer profile of beekeepers for this specific criteria: over 90% of large-scale multi-states beekeepers reported using a *Varroa* treatment product, compared to between 37 to 73% in the other 3 subsets of beekeepers (all years combined). As virtually all large-scale multi-states beekeepers reported the expert-identified "best" practice for that specific criteria, it is unsurprising that this criteria did not register as one of the most sensitive component of their index, because it would not represent a large improvement of the risks of colony mortality for that population. Our method would therefore avoid the futile recommendation of a behavior already largely implemented in that group.

By contrast, the criteria identified with the second highest potential for large-scale multi-states operations was "*Varroa* monitoring technique". The 2 most prevalent methods of *Varroa* monitoring for this group were visual inspection of bees (selected by 47.9% of large-scale multi-states beekeepers) and visual inspection of drone brood (selected by 57.5%). Though beekeepers were allowed to select multiple monitoring methods, it remains that a high proportion of those beekeepers rely, at least partly, on monitoring methods known to be highly unreliable (Honey Bee Health Coalition, 2015). Though this same sub-population exhibit a treatment regimen close to experts' recommendations, their choice of monitoring technique might imperil their abilities to detect damaging pests' levels, and thereby leaving them unaware of potential re-infestations or treatment failures. The importance of *Varroa* monitoring after treatment had already been highlighted as a risk factor for elevated *Varroa* levels (Giacobino et al., 2014), though the method of monitoring was not specified.

The ranking of criteria should be seen, not as the identification of the most influential management practices on overwinter colony loss, but the prioritization of the criteria for which a change of behavior would be associated with the greatest reduction in the risk of overwinter loss at the population level. Our methodology opens the door to a systematic benchmarking of beekeepers, comparing their management practices to analogous operations. We have demonstrated the use of this methodology in 4 specific subsets of beekeepers based on type of operations and regions, but with increasing participation, the level of refinement of the subsets could be improved. In particular, the subdivision into regions was limited to 2 levels, but could be implemented to more localized subgroups if the sample size allows it.

Improved Management Practices

Through the ranking and simplification process, we found that, globally, a majority of beekeepers could expect the greatest reduction in mortality risk by modifying their behavior in terms of comb management, source of new colonies and *Varroa* management. This holds particularly true for small-scale beekeepers, which represents the majority of beekeepers in our respondent pool and in the stakeholder community. Concretely, small-scale beekeepers should adopt a more active beekeeping management, actively replacing their deadouts throughout the active season (Action on Deadouts). When brood comb was taken out of production, it should ideally not been reused unless frozen for a period of time (Comb culling and storage). Small-scale beekeepers starting their colonies from packages should expect a higher level of loss over the winter (New Colonies Technique) compared to the ideal situation consisting of making splits from existing colonies. Finally, the importance of *Varroa* control is reflected by more than one top ranking criteria (among others, *Varroa* Treatment Y/N, *Varroa* products types (count), and various products use), highlighting the benefits of applying a strict *Varroa* control program. This suggests that there exist some variability in the optimum *Varroa* control methods, but in any cases, the use of any type of *Varroa* control treatment is highly associated with reduction of colony mortality risk compared to the no-treatment option.

For large-scale beekeepers, practices were less generally associated with a reduction in risk. Honey production ranked highly among large-scale beekeepers' management criteria. This could indicates the importance to place colonies in an environment conductive to good honey production. Though *Varroa* control was also associated with a high potential for risk reduction in single-state beekeepers, multi-states beekeepers' top recommendation regarding *Varroa* would be to use appropriate monitoring techniques.

Among others, our methodology brought forward unexpected results which could be translated into research opportunities. For example, the apparent lack of impact of supplemental feeding, or the varying potential of queen renewal and queen age.

Conclusion

The methodology developed in this paper proposes an expertise-driven analyze that, first, summarize management information in a simple metric associated with a measure of success (here, overwintering colony mortality) and secondly, prioritize the components of the index to identify which variables our outcome is most sensitive to, which represents the management criteria associated with the highest potential reduction in risk of colony mortality. This methodology particular strengths are its applicability to noisy and incomplete datasets that are typical in observational studies, but also its flexibility, as the complexity of the index structure could evolve to reflect the continuous improved understanding of the system.

We were able to demonstrate that overwintering colony mortality is highly significantly associated with the quality of management practices, as identified by experts, and most sensitive to various sets of practices according to the group of stakeholder and region concerned. The good performance of the General Management Index can serve as a validation of the opinion of the experts in regard to the general directionality in the scoring of the management criteria. However, the sensitivity ranking of criteria, for the all respondents or for each subgroup, did not correspond to the prediction of the experts as to which criteria would be the most influential on colony loss. This is because the sensitivity analysis also integrates the information on the prevalence of the practice, to prioritize criteria for which a behavior change would be associated with the highest reward in terms of reduction of loss risk.

From a comprehensive set of 72 criteria ranging several domains of management practice, we developed a simple index of management practices based on the top 21 most sensitive practices. From internal validation using bootstrap, we found those 21 criteria were satisfactorily stable, in particular for small-scale beekeepers that represent the majority of our survey respondents. We also prioritized different sets of criteria for each of the 4 subsets of beekeepers in our study, allowing us to provide specific and relevant recommendations based on the beekeeper's typology. This personalization of recommendations seemed even more necessary for large-scale beekeepers, as their average level of practices were already more in line with experts' recommendations that the average small-scale beekeeper.

Though management practices are only one of the factors impacting colony loss, it is almost entirely under the control of the beekeeper. If improving management practices will not mitigate all colony losses, our result indicate a potential reduction in risk of overwintering loss that is far from negligible and could help alleviate stress on both bees and beekeepers.

General Conclusion

This dissertation attempted to answer to the demand for a better understanding of the drivers of colony mortality and identification of suites of management practices which are optimal for colony survivorship by targeting each of the following specific goals:

1) Summarizing the state of knowledge on the causes of colony loss and their relative risk (Chapter 1);

2) Describing the epidemiological tools used to investigate the issue of honey bee colony health (Chapter 2);

3) Describing the variability of colony loss across seasons, space, stakeholder typology and over time (Chapters 3 and 4);

4) Investigating the association between management practices and the risk of colony mortality (Chapter 5).

Managed Honey bees (*A. mellifera* L.) represent a unique opportunity to investigate complex health issues affecting a social species. Honey bee health, and ultimately, colony loss, is affected by multiple stressors acting concomitantly and sometimes interacting (see Chapter 1). Those stressors include pests and diseases, forage availability and pesticide exposure. In most cases, pests and pathogens remain the proximal and most tangible cause of colony loss. Given the variability in stressor's prevalence, the complex web of inter-relations between potential risk co-factors, and the dynamic nature of the system, risk assessments need to be performed at a local scale and consider changes of both severity of impact and prevalence of the stressor over time.

A long list of indicators and methods can be used as measures of honey bee health (see Chapter 2). Traditionally, population size has been used as a proxy for the availability of pollination services, but act as a poor indicator of health for managed populations such as the honey bees. Colony production rate can be artificially magnified by beekeepers. As a result, even high levels of mortality do not necessarily translate into reduction in population size. In addition, population size is highly influenced by socio-economic factors, such as the price of honey and/or pollination demand. Because of the ability to replace dead out colonies quickly, which is particular to managed systems (as opposed to wild pollinators), honey bee health is better represented by measuring the rate of colony mortality over a defined time frame. High levels of colony loss over the winter and throughout the year seriously threaten the sustainability of beekeeping operations. Replacing dead colonies is costly, both directly (*e.g.* purchase of queens and bees) and indirectly, resulting from reduced productivity of split colonies. Though we do not believe that honey bee populations are threatened by the current level of colony loss, their contribution as primary managed pollinators of agricultural crops could be compromised. Other measures of health should complement mortality rates to provide broader perspective on the issue, for example, colony size or genetic diversity in terms of locally adapted ecotypes (see Chapter 1).

In the decade of Loss Surveys (2007 to 2017), US beekeepers lost an average of 27.8% of colonies over the winter (10 year average of Total Winter Loss, 95% CI 27.7-28%, see Chapter 4). To account for potential misrepresentation between beekeepers, we calibrated our Loss estimates to a target population structure. The resulted adjusted National Estimates, corrected for representation of States and multi-states colonies, were within 3 percentage points of our crude estimates, with the highest effects limited to the first two iterations of the survey before the use of the online platform. This reassured us that our national estimates' variation across years were not an effect of change in the representation of our respondents.

There is however substantial variation in the level of colony loss experienced throughout the stakeholder's population, both geographically and by type of operation. Commercial beekeepers lost significantly more colonies over the summer than backyard beekeepers, but significantly less colonies over the winter and over the entire season. This might be indicative of a different strategy between those 2 types of stakeholders, in which commercial beekeepers actively "take their losses" in the fall, by combining weak colonies before winter. Until recently, losses over the summer were disregarded. This result highlight the continuing need to monitor mortality rates throughout the season. State level loss was variable through time, though there was indications that states that shared similar stakeholder structure tended to share similar trends. We note the difficulty to assign colonies from multi-state operations (which represent over 88% of the number of colonies) to specific States. At the operational level, we observed the full range of loss, from 0 to 100%, indicating the variability in loss level experienced by our stakeholders. There was evidence of a reduction over the 10 years of survey in the probability for backyard beekeepers to report no loss over the winter, summer and entire season. Large-scale and long-term surveys such as this one, are important tools allowing us to better understand honey bee health and the challenges facing the beekeeping industry.

Management practices have the potential to buffer or exacerbate some of the stressors affecting honey bees, and ultimately impact colony mortality (Chapter 1). We confirmed the association between management practices quality and overwintering colony loss in a holistic manner (Chapter 5). We developed a methodology that, first, summarize management information in a simple metric reflecting the opinion of experts and associated with colony mortality, and secondly, identify the various sets of most sensitive practices according to the group of stakeholder and region concerned. We propose that those sets of practices should be prioritized as targets of behavior change to derive the highest reduction in risk of colony mortality. Interestingly, though the opinion of experts was globally validated by the good performance of the management indices, their prediction as to which practices would be most influential on colony loss was not matched by our resulting sets of most sensitive practices. This might be due to the added value of the sensitivity analyses which integrated the information on the pre-existing prevalence of the practice, to prioritize criteria for which a behavior change would be associated with the highest reward in terms of reduction of loss risk.

The sets of most sensitive management practices varied by operation type, with the most defined and stable set of practices to prioritize for small-scale operations compared to large-scale operations. This might indicate the existence of prevalent sub-optimal practices in small-scale beekeepers, resulting in widely applicable recommendations that would be associated with a high potential for reduction in colony mortality. On the other hand, large-scale operations, which performed better, with both higher management scores and lower mortality levels, would require more targeted recommendations, indicating the need – and potential – for benchmarking approaches.

Though management practices are only one of the factors impacting colony loss (Chapter 1), it is almost entirely under the control of the beekeeper. The effect size associated with our index (Chapter 5) indicate a small but significant reduction in colony loss risk associated with improved management practices. If improving management practices will not mitigate all colony losses, our results indicate a potential reduction in risk of overwintering loss that is far from negligible and could help alleviate stress on both bees and beekeepers.

In many systems, including honey bees, the investigations of sets of management practices have been frustrated by the lack of methodology to handle large complex and incomplete datasets that are typical in observational studies. While we tested out our methods on an extensive honey bee survivorship and management data set, we believe they could benefit other Ag or epidemiological systems interested in the summarization of a great number of practices and their prioritization based on highest potential to reduce risk.

Appendices

Appendix 1. <u>NASS Estimates</u>

			BIP Surveys				NASS Honey			NASS Census		NASS Census extrapolated						NASS Honey Bee Colonies					
Initials	State	Survey Year	N	Start Colonies	%N	% Start Col.	Honey Producing Col.	% H.p.col.	Col. allotment residuals	All Farms	All Colonies	All Farms	All Colonies	% Farms	% Colonies	Farm allotment residuals	Col. allotment residuals	StartColonies_Apr	StartColonies_Jan	StartColonies_Jul	StartColonies_Oct	%Oct.Col	Oct.Co.Residuals
USA	United States	2007-08	506	477,298	.	.	2,443,000	.	.	27,908	2,902,732	27,908	2,902,732	.	.	.	.	.	.	.	.		
		2008-09	777	461,980	.	.	2,342,000	.	.	.	.	30,496	2,997,692	.	.	.	.	.	.	.	.		
		2009-10	4,212	436,354	.	.	2,498,000	.	.	.	.	33,085	3,092,651	.	.	.	.	.	.	.	.		
		2010-11	5,556	326,763	.	.	2,692,000	.	.	.	.	33,085	3,092,651	.	.	.	.	.	.	.	.		
		2011-12	5,466	353,359	.	.	2,491,000	.	.	.	.	35,673	3,187,611	.	.	.	.	.	.	.	.		
		2012-13	6,486	646,008	.	.	2,539,000	.	.	38,261	3,282,570	38,261	3,282,570	.	.	.	.	.	.	.	.		
		2013-14	7,193	505,242	.	.	2,640,000	.	.	.	.	38,261	3,282,570	.	.	.	.	.	.	.	.		
		2014-15	5,937	414,267	.	.	2,740,000	.	.	.	.	38,261	3,282,570	.	.	.	.	.	.	.	.		
		2015-16	5,725	427,652	.	.	2,660,000	.	.	.	.	38,261	3,282,570	.	.	.	.	2,849,500	2,824,610	3,132,880	2,874,760		
		2016-17	4,983	371,626	.	.	2,775,000	.	.	.	.	38,261	3,282,570	.	.	.	.	2,801,470	2,619,940	3,181,180	3,032,060		
USA	United States	2007-2017	46,841	4,420,549	.	.	25,820,000	.	.			351,551	31,686,186	.	.	.	.	5,650,970	5,444,550	6,314,060	5,906,820		
AL	Alabama	2007-08	16	4,848	3.1621	1.0157	11,000	0.4503	0.5655	587	13,464	587	13,464	2.1033	0.4638	1.0587	0.5519	.	.	.	.		
		2008-09	1	19	0.1287	0.0041	9,000	0.3843	-0.3802	.	.	630	13,005	2.0650	0.4338	-1.9363	-0.4297	.	.	.	.		
		2009-10	46	1,357	1.0921	0.3110	9,000	0.3603	-0.0493	.	.	673	12,546	2.0327	0.4057	-0.9406	-0.0947	.	.	.	.		
		2010-11	34	476	0.6120	0.1457	9,000	0.3343	-0.1887	.	.	673	12,546	2.0327	0.4057	-1.4207	-0.2600	.	.	.	.		
		2011-12	40	539	0.7318	0.1525	9,000	0.3613	-0.2088	.	.	715	12,087	2.0050	0.3792	-1.2732	-0.2267	.	.	.	.		
		2012-13	50	2,667	0.7709	0.4128	8,000	0.3151	0.0978	758	11,628	758	11,628	1.9811	0.3542	-1.2102	0.0586	.	.	.	.		
		2013-14	38	345	0.5283	0.0683	7,000	0.2652	-0.1969	.	.	758	11,628	1.9811	0.3542	-1.4528	-0.2860	.	.	.	.		
		2014-15	31	354	0.5221	0.0855	7,000	0.2555	-0.1700	.	.	758	11,628	1.9811	0.3542	-1.4590	-0.2688	.	.	.	.		
		2015-16	47	463	0.8210	0.1083	7,000	0.2632	-0.1549	.	.	758	11,628	1.9811	0.3542	-1.1602	-0.2460	7,500	7,000	8,500	8,000	0.0026	-0.1700
		2016-17	43	473	0.8629	0.1273	7,000	0.2523	-0.1250	.	.	758	11,628	1.9811	0.3542	-1.1182	-0.2270	8,000	7,500	8,000	7,000	0.0023	-0.1036
AL	Alabama	2007-2017	346	11,541	0.7387	0.2611	83,000	0.3215	-0.0604			7,067	121,788	2.0102	0.3844	-1.2716	-0.1298	15,500	14,500	16,500	15,000	0.0025	0.0071
AK	Alaska	2007-08	0	0	0.0000	0.0000	(P)			20	337	20	337	0.0717	0.0116	-0.0717	-0.0116	.	.	.	.		
		2008-09	1	1	0.1287	0.0002	(P)			.	.	24	389	0.0779	0.0130	0.0508	-0.0128	.	.	.	.		
		2009-10	3	9	0.0712	0.0021	(P)			.	.	28	442	0.0831	0.0143	-0.0119	-0.0122	.	.	.	.		
		2010-11	3	1,407	0.0540	0.4306	(P)			.	.	28	442	0.0831	0.0143	-0.0291	0.4163	.	.	.	.		
		2011-12	1	6	0.0183	0.0017	(P)			.	.	31	494	0.0876	0.0155	-0.0693	-0.0138	.	.	.	.		
		2012-13	3	35	0.0463	0.0054	(P)			35	546	35	546	0.0915	0.0166	-0.0452	-0.0112	.	.	.	.		
		2013-14	5	21	0.0695	0.0042	(P)			.	.	35	546	0.0915	0.0166	-0.0220	-0.0125	.	.	.	.		
		2014-15	2	11	0.0337	0.0027	(P)			.	.	35	546	0.0915	0.0166	-0.0578	-0.0140	.	.	.	.		
		2015-16	5	19	0.0873	0.0044	(P)			.	.	35	546	0.0915	0.0166	-0.0041	-0.0122	.	.	.	.		
		2016-17	2	8	0.0401	0.0022	(P)			.	.	35	546	0.0915	0.0166	-0.0513	-0.0145	.	.	.	.		
AK	Alaska	2007-2017	25	1,517	0.0534	0.0343	(P)					305	4,833	0.0868	0.0153	-0.0334	0.0191						
AZ	Arizona	2007-08	1	7,400	0.1976	1.5504	30,000	1.2280	0.3224	106	42,239	106	42,239	0.3798	1.4551	-0.1822	0.0952	.	.	.	.		
		2008-09	2	27,008	0.2574	5.8461	25,000	1.0675	4.7787	.	.	135	46,295	0.4410	1.5443	-0.1836	4.3018	.	.	.	.		
		2009-10	5	2,136	0.1187	0.4895	20,000	0.8006	-0.3111	.	.	163	50,350	0.4927	1.6281	-0.3740	-1.1385	.	.	.	.		
		2010-11	7	41	0.1260	0.0125	24,000	0.8915	-0.8790	.	.	163	50,350	0.4927	1.6281	-0.3667	-1.6155	.	.	.	.		
		2011-12	8	447	0.1464	0.1265	23,000	0.9233	-0.7968	.	.	192	54,406	0.5368	1.7068	-0.3905	-1.5803	.	.	.	.		
		2012-13	13	2,069	0.2004	0.3203	22,000	0.8665	-0.5462	220	58,461	220	58,461	0.5750	1.7810	-0.3746	-1.4607	.	.	.	.		
		2013-14	6	362	0.0834	0.0716	29,000	1.0985	-1.0268	.	.	220	58,461	0.5750	1.7810	-0.4916	-1.7093	.	.	.	.		
		2014-15	10	1,032	0.1684	0.2491	26,000	0.9489	-0.6998	.	.	220	58,461	0.5750	1.7810	-0.4066	-1.5318	.	.	.	.		
		2015-16	8	43	0.1397	0.0101	26,000	0.9774	-0.9674	.	.	220	58,461	0.5750	1.7810	-0.4353	-1.7709	33,000	35,000	40,000	36,000	0.0125	-1.2422
		2016-17	10	474	0.2007	0.1275	27,000	0.9730	-0.8454	.	.	220	58,461	0.5750	1.7810	-0.3743	-1.6534	22,000	30,000	30,000	29,000	0.0096	-0.8289
AZ	Arizona	2007-2017	70	41,012	0.1494	0.9278	252,000	0.9760	-0.0482			1,858	535,944	0.5285	1.6914	-0.3791	-0.7637	55,000	65,000	70,000	65,000	0.0110	-0.1727
AR	Arkansas	2007-08	20	16,955	3.9526	3.5523	28,000	1.1461	2.4062	611	31,865	611	31,865	2.1893	1.0978	1.7632	2.4545	.	.	.	.		
		2008-09	28	7,894	3.6036	1.6005	28,000	1.1956	0.4049	.	.	596	29,714	1.9535	0.9912	1.6501	0.6093	.	.	.	.		
		2009-10	50	447	1.1871	0.1024	24,000	0.9608	-0.8583	.	.	581	27,562	1.7546	0.8912	-0.5675	-0.7888	.	.	.	.		
		2010-11	43	297	0.7739	0.0909	25,000	0.9287	-0.8378	.	.	581	27,562	1.7546	0.8912	-0.9807	-0.8003	.	.	.	.		
		2011-12	41	383	0.7501	0.1084	22,000	0.8832	-0.7748	.	.	565	25,411	1.5845	0.7972	-0.8345	-0.6888	.	.	.	.		
		2012-13	56	1,988	0.8634	0.3077	25,000	0.9846	-0.6769	550	23,259	550	23,259	1.4375	0.7086	-0.5741	-0.4008	.	.	.	.		
		2013-14	74	8,676	1.0288	1.7172	22,000	0.8333	0.8839	.	.	550	23,259	1.4375	0.7086	-0.4087	1.0086	.	.	.	.		
		2014-15	103	2,072	1.7349	0.5002	21,000	0.7664	-0.2663	.	.	550	23,259	1.4375	0.7086	0.2974	-0.2084	.	.	.	.		
		2015-16	43	1,216	0.7511	0.2843	24,000	0.9023	-0.6179	.	.	550	23,259	1.4375	0.7086	-0.6864	-0.4242	13,500	13,000	23,000	23,000	0.0080	-0.5157
		2016-17	39	2,429	0.7827	0.6536	24,000	0.8649	-0.2113	.	.	550	23,259	1.4375	0.7086	-0.6548	-0.0549	24,000	27,000	32,000	28,000	0.0092	-0.2699
AR	Arkansas	2007-2017	497	41,857	1.0610	0.9469	243,000	0.9411	0.0057			5,683	258,408	1.6166	0.8155	-0.5555	0.1314	37,500	40,000	55,000	51,000	0.0086	0.0835
CA	California	2007-08	36	184,085	7.1146	38.5681	340,000	13.9173	24.6508	1,155	655,817	1,155	655,817	4.1386	22.5931	2.9760	15.9751	.	.	.	.		
		2008-09	60	266,566	7.7220	57.7008	360,000	15.3715	42.3293	.	.	1,339	728,260	4.3899	24.2940	3.3321	33.4067	.	.	.	.		
		2009-10	166	333,778	3.9411	76.4925	355,000	14.2114	62.2811	.	.	1,529	800,703	4.6019	25.8905	-0.6607	50.6020	.	.	.	.		
		2010-11	327	248,736	5.8855	76.1212	410,000	15.2303	60.8909	.	.	1,529	800,703	4.6019	25.8905	1.2837	50.2307	.	.	.	.		
		2011-12	301	245,111	5.5068	69.3660	370,000	14.8535	54.5125	.	.	1,706	873,146	4.7831	27.3919	0.7237	41.9741	.	.	.	.		
		2012-13	292	490,737	4.5020	75.9645	330,000	12.9972	62.9673	1,890	945,589	1,890	945,589	4.9398	28.8064	-0.4378	47.1582	.	.	.	.		
		2013-14	293	392,531	4.0734	77.6917	330,000	12.5000	65.1917	.	.	1,890	945,589	4.9398	28.8064	-0.8664	48.8853	.	.	.	.		
		2014-15	208	320,003	3.5035	77.2456	320,000	11.6788	65.5668	.	.	1,890	945,589	4.9398	28.8064	-1.4363	48.4392	.	.	.	.		
		2015-16	204	330,890	3.5633	77.3737	275,000	10.3383	67.0353	.	.	1,890	945,589	4.9398	28.8064	-1.3764	48.5673	1,040,000	1,440,000	730,000	750,000	0.2609	51.2845
		2016-17	184	298,101	3.6926	80.2153	310,000	11.1712	69.0442	.	.	1,890	945,589	4.9398	28.8064	-1.2472	51.4090	1,110,000	1,130,000	740,000	770,000	0.2540	54.8200
CA	California	2007-2017	2,071	3,110,538	4.4213	70.3854	3,400,000	13.1681	57.1978			16,695	8,586,574	4.7490	27.0988	-0.3276	43.2666	2,150,000	2,570,000	1,470,000	1,520,000	0.2573	44.6325
CO	Colorado	2007-08	3	2,625	0.5929	0.5500	31,000	1.2689	-0.7190	388	33,201	388	33,201	1.3903	1.1438	-0.7974	-0.5938	.	.	.	.		
		2008-09	2	3,005	0.2574	0.6505	27,000	1.1529	-0.5024	.	.	446	33,604	1.4617	1.1210	-1.2049	-0.4705	.	.	.	.		
		2009-10	99	6,627	2.3504	1.5187	28,000	1.1209	0.3978	.	.	504	34,007	1.5219	1.0996	0.8286	0.4191	.	.	.	.		
		2010-11	137	1,744	2.4658	0.5337	34,000	1.2630	-0.7293	.	.	504	34,007	1.5219	1.0996	0.9439	-0.5659	.	.	.	.		
		2011-12	129	1,227	2.3600	0.3472	31,000	1.2445	-0.8972	.	.	561	34,410	1.5733	1.0795	0.7867	-0.7323	.	.	.	.		
		2012-13	314	1,694	4.8412	0.2622	25,000	0.9846	-0.7224	619	34,813	619	34,813	1.6178	1.0605	3.2234	-0.7983	.	.	.	.		
		2013-14	224	68,982	3.1141	13.6533	26,000	0.9848	12.6684	.	.	619	34,813	1.6178	1.0605	1.4963	12.5927	.	.	.	.		
		2014-15	214	63,126	3.6045	15.2380	27,000	0.9854	14.2526	.	.	619	34,813	1.6178	1.0605	1.9867	14.1775	.	.	.	.		
		2015-16	185	3,259	3.2314	0.7607	29,000	1.0902	-0.3296	.	.	619	34,813	1.6178	1.0605	1.6136	-0.2999	12,000	3,500	29,000	24,000	0.0083	-0.0742
		2016-17	131	768	2.6289	0.2067	32,000	1.1532	-0.9465	.	.	619	34,813	1.6178	1.0605	1.0111	-0.8539	9,500	5,000	33,000	30,000	0.0099	-0.7828
CO	Colorado	2007-2017	1,438	153,051	3.0700	3.4623	290,000	1.1232	2.3391			5,497	343,294	1.5636	1.0834	1.5063	2.3788	21,500	8,500	62,000	54,000	0.0091	2.5481
CT	Connecticut	2007-08	0	0	0.0000	0.0000	(P)			215	4,427	215	4,427	0.7704	0.1525	-0.7704	-0.1525	.	.	.	.		
		2008-09	4	54	0.5148	0.0117	(P)			.	.	261	4,730	0.8542	0.1578	-0.3394	-0.1461	.	.	.	.		
		2009-10	58	742	1.3770	0.1700	(P)			.	.	306	5,033	0.9249	0.1627	0.4521	0.0073	.	.	.	.		
		2010-11	102	884	1.8359	0.2705	(P)			.	.	306	5,033	0.9249	0.1627	0.9109	0.1078	.	.	.	.		
		2011-12	60	682	1.0977	0.1930	(P)			.	.	352	5,336	0.9853	0.1674	0.1123	0.0256	.	.	.	.		
		2012-13	78	1,009	1.2026	0.1562	(P)			397	5,639	397	5,639	1.0376	0.1718	0.1650	-0.0156	.	.	.	.		
		2013-14	77	816	1.0705	0.1615	(P)			.	.	397	5,639	1.0376	0.1718	0.0329	-0.0103	.	.	.	.		
		2014-15	71	701	1.1959	0.1692	(P)			.	.	397	5,639	1.0376	0.1718	0.1583	-0.0026	.	.	.	.		
		2015-16	75	795	1.3100	0.1859	(P)			.	.	397	5,639	1.0376	0.1718	0.2724	0.0141	3,000	3,900	3,700	3,200	0.0011	0.0746
		2016-17	44	391	0.8830	0.1052	(P)			.	.	397	5,639	1.0376	0.1718	-0.1546	-0.0666	2,500	2,700	3,100	3,100	0.0010	0.0030
CT	Connecticut	2007-2017	569	6,074	1.2147	0.1374	(P)					3,424	52,754	0.9740	0.1665	0.2408	-0.0291	5,500	6,600	6,800	6,300	0.0011	0.0307
DE	Delaware	2007-08	0	0	0.0000	0.0000	(P)			48	546	48	546	0.1720	0.0188	-0.1720	-0.0188	.	.	.	.		
		2008-09	1	2	0.1287	0.0004	(P)			.	.	47	614	0.1549	0.0205	-0.0262	-0.0200	.	.	.	.		
		2009-10	15	95	0.3561	0.0218	(P)			.	.	47	682	0.1405	0.0220	0.2156	-0.0003	.	.	.	.		
		2010-11	15	61	0.2700	0.0187	(P)			.	.	47	682	0.1405	0.0220	0.1294	-0.0034	.	.	.	.		
		2011-12	29	420	0.5306	0.1189	(P)			.	.	46	749	0.1282	0.0235	0.4023	0.0954	.	.	.	.		
		2012-13	33	10,010	0.5088	1.5495	(P)			45	817	45	817	0.1176	0.0249	0.3912	1.5246	.	.	.	.		
		2013-14	28	10,160	0.3893	2.0109	(P)			.	.	45	817	0.1176	0.0249	0.2717	1.9860	.	.	.	.		
		2014-15	20	18,426	0.3369	4.4479	(P)			.	.	45	817	0.1176	0.0249	0.2193	4.4230	.	.	.	.		
		2015-16	24	10,636	0.4192	2.4871	(P)			.	.	45	817	0.1176	0.0249	0.3016	2.4622	.	.	.	.		
		2016-17	46	411	0.9231	0.1106	(P)			.	.	45	817	0.1176	0.0249	0.8055	0.0857	.	.	.	.		
DE	Delaware	2007-2017	211	50,221	0.4505	1.1361	(P)					459	7,357	0.1306	0.0232	0.3199	1.1129						
DC	District of Columbia	2007-08	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
		2008-09	1	5	0.1287	0.0011	(P)			.	.	.	.					.	.	.	.		
		2009-10	2	10	0.0475	0.0023	(P)			.	.	.	.					.	.	.	.		
		2010-11	3	62	0.0540	0.0190	(P)			.	.	.	.					.	.	.	.		
		2011-12	11	3,062	0.2012	0.8665	(P)			.	.	.	.					.	.	.	.		
		2012-13	14	300	0.2158	0.0464	(P)			.	.	.	.					.	.	.	.		
		2013-14	8	192	0.1112	0.0380	(P)			.	.	.	.					.	.	.	.		
		2014-15	5	265	0.0842	0.0640	(P)			.	.	.	.					.	.	.	.		
		2015-16	8	117	0.1397	0.0274	(P)			.	.	.	.					.	.	.	.		
		2016-17	25	101	0.5017	0.0272	(P)			.	.	.	.					.	.	.	.		
DC	District of Columbia	2007-2017	77	4,114	0.1644	0.0931	(P)				.	.	.										
FL	Florida	2007-08	23	50,897	4.5455	10.6636	160,000	6.5493	4.1142	785	158,905	785	158,905	2.6337	5.4743	1.9118	5.1892	.	.	.	.		
		2008-09	20	28,304	2.5740	6.1267	150,000	6.4048	-0.2781	.	.	806	170,842	2.6421	5.6991	-0.0681	0.4275	.	.	.	.		
		2009-10	153	32,900	3.6325	7.5397	170,000	6.8054	0.7343	.	.	877	182,780	2.6493	5.9101	0.9832	1.6296	.	.	.	.		
		2010-11	133	28,065	2.3938	8.5888	200,000	7.4294	1.1594	.	.	877	182,780	2.6493	5.9101	-0.2565	2.6787	.	.	.	.		

Initials	State	Survey Year	N	Start Colonies	%N	% Start Col.	Honey Producing Col.	% H.p.col.	Col. allotment residuals	All Farms	All Colonies	All Farms	All Colonies	% Farms	% Colonies	Farm allotment residuals	Col. allotment residuals	StartColonies_Apr	StartColonies_Jan	StartColonies_Jul	StartColonies_Oct	%Oct.Col	Oct.Co.Residuals
			BIP Surveys				NASS Honey			NASS Census		NASS Census extrapolated						NASS Honey Bee Colonies					
		2011-12	106	35,153	1.9393	9.9482	180,000	7.2260	2.7222	.	.	947	194,717	2.6554	6.1085	-0.7161	3.8397	.	.	.	.		
		2012-13	136	49,702	2.0968	7.6937	193,000	7.6014	0.0923	1,018	206,654	1,018	206,654	2.6607	6.2955	-0.5638	1.3982	.	.	.	.		
		2013-14	166	51,693	2.3078	10.2313	220,000	8.3333	1.8980	.	.	1,018	206,654	2.6607	6.2955	-0.3529	3.9358	.	.	.	.		
		2014-15	111	27,403	1.8696	6.6148	245,000	8.9416	-2.3268	.	.	1,018	206,654	2.6607	6.2955	-0.7910	0.3193	.	.	.	.		
		2015-16	61	26,647	1.0655	6.2310	220,000	8.2707	-2.0397	.	.	1,018	206,654	2.6607	6.2955	-1.5952	-0.0645	210,000	305,000	164,000	220,000	0.0765	-1.4218
		2016-17	67	72,665	1.3446	19.5538	215,000	7.7477	11.8055	.	.	1,018	206,654	2.6607	6.2955	-1.3161	13.2578	240,000	275,000	200,000	255,000	0.0841	11.1431
FL	Florida	2007-2017	976	403,429	2.0836	9.1262	1,953,000	7.5639	1.5623			9,331	1,923,293	2.6542	6.0636	-0.5706	3.0564	450,000	580,000	364,000	475,000	0.0804	1.0847
GA	Georgia	2007-08	15	42,876	2.9644	8.9831	60,000	2.4560	6.5271	652	93,661	652	93,661	2.3362	3.2266	0.6282	5.7564	.	.	.	.		
		2008-09	44	7,269	5.6628	1.5734	65,000	2.7754	-1.2020	.	.	699	86,299	2.2904	2.8788	3.3724	-1.3054	.	.	.	.		
		2009-10	87	7,165	2.0655	1.6420	65,000	2.6021	-0.9601	.	.	745	78,937	2.2518	2.5524	-0.1863	-0.9104	.	.	.	.		
		2010-11	143	6,006	2.5738	1.8380	55,000	2.0431	-0.2051	.	.	745	78,937	2.2518	2.5524	0.3220	-0.7144	.	.	.	.		
		2011-12	148	10,446	2.7076	2.9562	65,000	2.6094	0.3468	.	.	792	71,575	2.2188	2.2454	0.4889	0.7108	.	.	.	.		
		2012-13	117	9,483	1.8039	1.4679	59,000	2.3237	-0.8558	838	64,213	838	64,213	2.1902	1.9562	-0.3863	-0.4882	.	.	.	.		
		2013-14	107	12,352	1.4876	2.4448	67,000	2.5379	-0.0931	.	.	838	64,213	2.1902	1.9562	-0.7027	0.4886	.	.	.	.		
		2014-15	81	3,977	1.3643	0.9600	73,000	2.6642	-1.7042	.	.	838	64,213	2.1902	1.9562	-0.8259	-0.9962	.	.	.	.		
		2015-16	71	1,424	1.2402	0.3330	69,000	2.5940	-2.2610	.	.	838	64,213	2.1902	1.9562	-0.9500	-1.6232	114,000	104,000	108,000	110,000	0.0383	-3.4934
		2016-17	87	25,580	1.7459	6.8833	96,000	3.4595	3.4238	.	.	838	64,213	2.1902	1.9562	-0.4443	4.9271	108,000	100,000	102,000	96,000	0.0317	3.7171
GA	Georgia	2007-2017	900	126,578	1.9214	2.8634	674,000	2.6104	0.2530			7,822	730,474	2.2250	2.3053	-0.3036	0.5581	222,000	204,000	210,000	206,000	0.0349	-0.6241
HI	Hawaii	2007-08	0	0	0.0000	0.0000	10,000	0.4093	-0.4093	271	16,665	271	16,665	0.9710	0.5741	-0.9710	-0.5741	.	.	.	.		
		2008-09	0	0	0.0000	0.0000	10,000	0.4270	-0.4270	.	.	254	14,656	0.8329	0.4889	-0.8329	-0.4889	.	.	.	.		
		2009-10	8	51	0.1899	0.0117	10,000	0.4003	-0.3886	.	.	237	12,648	0.7163	0.4090	-0.5264	-0.3973	.	.	.	.		
		2010-11	42	5,392	0.7559	1.6501	10,000	0.3715	1.2787	.	.	237	12,648	0.7163	0.4090	0.0396	1.2412	.	.	.	.		
		2011-12	29	9,903	0.5306	2.8025	9,000	0.3613	2.4412	.	.	220	10,639	0.6167	0.3338	-0.0862	2.4688	.	.	.	.		
		2012-13	61	12,900	0.9405	1.9969	10,000	0.3939	1.6030	203	8,630	203	8,630	0.5306	0.2629	0.4099	1.7340	.	.	.	.		
		2013-14	75	13,511	1.0427	2.6742	13,000	0.4924	2.1817	.	.	203	8,630	0.5306	0.2629	0.5121	2.4113	.	.	.	.		
		2014-15	34	10,165	0.5727	2.4537	15,000	0.5474	1.9063	.	.	203	8,630	0.5306	0.2629	0.0421	2.1908	.	.	.	.		
		2015-16	51	5,350	0.8908	1.2510	14,000	0.5263	0.7247	.	.	203	8,630	0.5306	0.2629	0.3603	0.9881	13,500	10,500	14,500	13,000	0.0045	0.7988
		2016-17	10	77	0.2007	0.0207	16,000	0.5766	-0.5559	.	.	203	8,630	0.5306	0.2629	-0.3299	-0.2422	13,500	15,000	13,500	13,500	0.0045	-0.4245
HI	Hawaii	2007-2017	310	57,349	0.6618	1.2973	117,000	0.4531	0.8442			2,234	110,405	0.6355	0.3484	0.0263	0.9489	27,000	25,500	28,000	26,500	0.0045	0.8487
ID	Idaho	2007-08	1	3,400	0.1976	0.7123	92,000	3.7659	-3.0535	179	119,379	179	119,379	0.6414	4.1126	-0.4438	-3.4003	.	.	.	.		
		2008-09	14	43,449	1.8018	9.4050	90,000	3.8429	5.5621	.	.	211	115,435	0.6902	3.8508	1.1116	5.5541	.	.	.	.		
		2009-10	27	23,211	0.6410	5.3193	103,000	4.1233	1.1960	.	.	242	111,492	0.7315	3.6050	-0.0904	1.7143	.	.	.	.		
		2010-11	27	9,325	0.4860	2.8538	97,000	3.6033	-0.7495	.	.	242	111,492	0.7315	3.6050	-0.2455	-0.7513	.	.	.	.		
		2011-12	42	12,203	0.7684	3.4534	87,000	3.4926	-0.0391	.	.	274	107,548	0.7667	3.3739	0.0017	0.0795	.	.	.	.		
		2012-13	41	66,660	0.6321	10.3188	92,000	3.6235	6.6953	305	103,604	305	103,604	0.7972	3.1562	-0.1650	7.1626	.	.	.	.		
		2013-14	41	96,469	0.5700	19.0936	83,000	3.1439	15.9497	.	.	305	103,604	0.7972	3.1562	-0.2272	15.9374	.	.	.	.		
		2014-15	62	74,921	1.0443	18.0852	100,000	3.6496	14.4356	.	.	305	103,604	0.7972	3.1562	0.2471	14.9290	.	.	.	.		
		2015-16	53	91,018	0.9258	21.2832	89,000	3.3459	17.9373	.	.	305	103,604	0.7972	3.1562	0.1286	18.1270	62,000	81,000	80,000	121,000	0.0421	17.0741
		2016-17	40	51,318	0.8027	13.8090	97,000	3.4955	10.3135	.	.	305	103,604	0.7972	3.1562	0.0056	10.6529	60,000	91,000	79,000	121,000	0.0399	9.8184
ID	Idaho	2007-2017	348	471,974	0.7429	10.6768	930,000	3.6019	7.0750			2,672	1,083,365	0.7601	3.4190	-0.0171	7.2578	122,000	172,000	159,000	242,000	0.0410	6.5799
IL	Illinois	2007-08	1	6	0.1976	0.0013	9,000	0.3684	-0.3671	497	9,390	497	9,390	1.7809	0.3235	-1.5832	-0.3222	.	.	.	.		
		2008-09	3	3	0.3861	0.0006	8,000	0.3416	-0.3409	.	.	603	9,553	1.9757	0.3187	-1.5896	-0.3180	.	.	.	.		
		2009-10	49	958	1.1633	0.2195	8,000	0.3203	-0.1007	.	.	708	9,717	2.1400	0.3142	-0.9766	-0.0946	.	.	.	.		
		2010-11	136	1,045	2.4478	0.3198	9,000	0.3343	-0.0145	.	.	708	9,717	2.1400	0.3142	0.3078	0.0056	.	.	.	.		
		2011-12	93	1,085	1.7014	0.3071	7,000	0.2810	0.0260	.	.	814	9,880	2.2805	0.3099	-0.5790	-0.0029	.	.	.	.		
		2012-13	202	5,281	3.1144	0.8175	7,000	0.2757	0.5418	919	10,043	919	10,043	2.4019	0.3059	0.7125	0.5115	.	.	.	.		
		2013-14	159	2,438	2.2105	0.4825	7,000	0.2652	0.2174	.	.	919	10,043	2.4019	0.3059	-0.1914	0.1766	.	.	.	.		
		2014-15	137	1,133	2.3076	0.2735	8,000	0.2920	-0.0185	.	.	919	10,043	2.4019	0.3059	-0.0944	-0.0325	.	.	.	.		
		2015-16	155	1,212	2.7074	0.2834	8,000	0.3008	-0.0173	.	.	919	10,043	2.4019	0.3059	0.3055	-0.0225	9,500	6,000	14,000	14,000	0.0049	-0.2096
		2016-17	121	2,053	2.4283	0.5524	10,000	0.3604	0.1921	.	.	919	10,043	2.4019	0.3059	0.0263	0.2465	9,000	8,500	11,000	9,000	0.0030	0.2556
IL	Illinois	2007-2017	1,056	15,214	2.2544	0.3442	81,000	0.3137	0.0305			7,924	98,471	2.2540	0.3108	0.0004	0.0334	18,500	14,500	25,000	23,000	0.0039	-0.0452
IN	Indiana	2007-08	0	0	0.0000	0.0000	8,000	0.3275	-0.3275	521	11,305	521	11,305	1.8668	0.3895	-1.8668	-0.3895	.	.	.	.		
		2008-09	2	10	0.2574	0.0022	7,000	0.2989	-0.2967	.	.	639	11,733	2.0553	0.3314	-1.8379	-0.3892	.	.	.	.		
		2009-10	85	4,141	2.0180	0.9490	9,000	0.3603	0.5887	.	.	757	12,161	2.2881	0.3392	-0.2700	0.5558	.	.	.	.		
		2010-11	152	1,205	2.7358	0.3688	10,000	0.3715	-0.0027	.	.	757	12,161	2.2881	0.3392	0.4477	-0.0245	.	.	.	.		
		2011-12	88	2,168	1.6100	0.6135	8,000	0.3212	0.2924	.	.	875	12,589	2.4529	0.3949	-0.8429	0.2186	.	.	.	.		
		2012-13	173	4,030	2.6679	0.6238	8,000	0.3151	0.3087	993	13,017	993	13,017	2.5953	0.3965	0.0720	0.2273	.	.	.	.		
		2013-14	216	3,719	3.0029	0.7949	6,000	0.2273	0.5676	.	.	993	13,017	2.5953	0.3965	0.4076	0.3983	.	.	.	.		
		2014-15	138	3,770	2.3244	0.9100	5,000	0.1825	0.7276	.	.	993	13,017	2.5953	0.3965	-0.2709	0.5135	.	.	.	.		
		2015-16	198	1,738	3.4585	0.4064	6,000	0.2256	0.1808	.	.	993	13,017	2.5953	0.3965	0.8632	0.0099	8,000	9,000	15,000	11,500	0.0040	0.0064
		2016-17	119	3,881	2.3881	1.0443	7,000	0.2523	0.7921	.	.	993	13,017	2.5953	0.3965	-0.2072	0.6478	4,300	6,500	9,500	7,500	0.0025	0.7970
IN	Indiana	2007-2017	1,171	24,656	2.4999	0.5578	74,000	0.2866	0.2712			8,514	125,034	2.4218	0.3946	0.0781	0.1632	12,300	15,500	24,500	19,000	0.0032	0.2361
IA	Iowa	2007-08	12	723	2.3715	0.1515	26,000	1.0643	-0.9128	482	29,110	482	29,110	1.7271	1.0028	0.6444	-0.8514	.	.	.	.		
		2008-09	17	11,703	2.1879	2.5332	24,000	1.0248	1.5085	.	.	524	29,334	1.7191	0.9785	0.4688	1.5547	.	.	.	.		
		2009-10	56	1,141	1.3295	0.2615	26,000	1.0408	-0.7793	.	.	567	29,557	1.7129	0.9557	-0.3827	-0.6942	.	.	.	.		
		2010-11	28	729	0.5040	0.2231	27,000	1.0030	-0.7799	.	.	567	29,557	1.7129	0.9557	-1.2089	-0.7326	.	.	.	.		
		2011-12	39	1,525	0.7135	0.4316	25,000	1.0036	-0.5720	.	.	609	29,781	1.7065	0.9343	-0.9930	-0.5027	.	.	.	.		
		2012-13	63	6,535	0.9713	1.0116	37,000	1.4573	-0.4457	651	30,004	651	30,004	1.7015	0.9140	-0.7301	0.0976	.	.	.	.		
		2013-14	61	1,257	0.8480	0.2488	39,000	1.4773	-1.2285	.	.	651	30,004	1.7015	0.9140	-0.8534	-0.6652	.	.	.	.		
		2014-15	47	947	0.7916	0.2286	35,000	1.2774	-1.0488	.	.	651	30,004	1.7015	0.9140	-0.9098	-0.6854	.	.	.	.		
		2015-16	55	917	0.9607	0.2144	36,000	1.3534	-1.1390	.	.	651	30,004	1.7015	0.9140	-0.7408	-0.6996	12,500	12,500	29,000	35,000	0.0122	-1.0031
		2016-17	85	788	1.7058	0.2120	37,000	1.3333	-1.1213	.	.	651	30,004	1.7015	0.9140	0.0043	-0.7020	10,500	13,000	50,000	54,000	0.0178	-1.5689
IA	Iowa	2007-2017	463	26,265	0.9885	0.5942	312,000	1.2084	-0.6142			6,003	297,358	1.7076	0.9384	-0.7191	-0.3443	23,000	25,500	79,000	89,000	0.0151	-0.9126
KS	Kansas	2007-08	1	3,500	0.1976	0.7339	14,000	0.5731	0.1602	306	11,977	306	11,977	1.0965	0.4126	-0.8988	0.3207	.	.	.	.		
		2008-09	0	0	0.0000	0.0000	10,000	0.4270	-0.4270	.	.	343	11,664	1.1255	0.3891	-1.1255	-0.3891	.	.	.	.		
		2009-10	10	5,251	0.2374	1.2034	9,000	0.3603	0.8431	.	.	381	11,352	1.1501	0.3670	-0.9127	0.8363	.	.	.	.		
		2010-11	21	401	0.3780	0.1227	9,000	0.3343	-0.2116	.	.	381	11,352	1.1501	0.3670	-0.7721	-0.2443	.	.	.	.		
		2011-12	23	534	0.4208	0.1511	7,000	0.2810	-0.1299	.	.	418	11,039	1.1711	0.3463	-0.7503	-0.1952	.	.	.	.		
		2012-13	51	2,329	0.7863	0.3605	6,000	0.2363	0.1242	455	10,726	455	10,726	1.1892	0.3268	-0.4029	0.0338	.	.	.	.		
		2013-14	43	575	0.5978	0.1138	6,000	0.2273	-0.1135	.	.	455	10,726	1.1892	0.3268	-0.5914	-0.2129	.	.	.	.		
		2014-15	44	871	0.7411	0.2103	7,000	0.2555	-0.0452	.	.	455	10,726	1.1892	0.3268	-0.4481	-0.1165	.	.	.	.		
		2015-16	36	4,000	0.6288	0.9353	8,000	0.3008	0.6346	.	.	455	10,726	1.1892	0.3268	-0.5604	0.6086	6,000	4,600	9,000	8,500	0.0030	0.6397
		2016-17	24	17,178	0.4816	4.6224	7,000	0.2523	4.3701	.	.	455	10,726	1.1892	0.3268	-0.7076	4.2956	4,700	5,000	8,000	5,000	0.0016	4.4575
KS	Kansas	2007-2017	253	34,639	0.5401	0.7836	83,000	0.3215	0.4621			4,103	111,013	1.1671	0.3504	-0.6270	0.4332	10,700	9,600	17,000	13,500	0.0023	0.5550
KY	Kentucky	2007-08	0	0	0.0000	0.0000	4,000	0.1637	-0.1637	1,325	10,796	1,325	10,796	4.7477	0.3719	-4.7477	-0.3719	.	.	.	.		
		2008-09	1	5	0.1287	0.0011	4,000	0.1708	-0.1697	.	.	1,461	11,264	4.7908	0.3758	-4.6621	-0.3747	.	.	.	.		
		2009-10	25	613	0.5985	0.1405	5,000	0.2002	-0.0597	.	.	1,597	11,733	4.8270	0.3794	-4.2285	-0.2388	.	.	.	.		
		2010-11	55	931	0.9899	0.2849	5,000	0.1857	0.0992	.	.	1,597	11,733	4.8270	0.3794	-3.8371	-0.0945	.	.	.	.		
		2011-12	46	705	0.8416	0.1995	4,000	0.1606	0.0389	.	.	1,733	12,201	4.8580	0.3828	-4.0165	-0.1832	.	.	.	.		
		2012-13	67	749	1.0330	0.1159	5,000	0.1969	-0.0810	1,869	12,669	1,869	12,669	4.8849	0.3859	-3.8519	-0.2700	.	.	.	.		
		2013-14	112	1,500	1.5571	0.2969	3,000	0.1136	0.1833	.	.	1,869	12,669	4.8849	0.3859	-3.3278	-0.0891	.	.	.	.		
		2014-15	70	674	1.1790	0.1627	5,000	0.1825	-0.0198	.	.	1,869	12,669	4.8849	0.3859	-3.7058	-0.2232	.	.	.	.		
		2015-16	81	726	1.4148	0.1698	5,000	0.1880	-0.0182	.	.	1,869	12,669	4.8849	0.3859	-3.4700	-0.2162	7,500	7,500	10,000	8,500	0.0030	-0.1259
		2016-17	59	1,649	1.0636	0.4437	5,000	0.1802	0.2635	.	.	1,869	12,669	4.8849	0.3859	-3.8213	0.0578	5,500	6,500	7,500	7,500	0.0025	0.1964
KY	Kentucky	2007-2017	510	7,552	1.0888	0.1708	45,000	0.1743	-0.0034			17,058	121,071	4.8522	0.3821	-3.7634	-0.2113	13,000	14,000	17,500	16,000	0.0027	-0.1000
LA	Louisiana	2007-08	4	28,779	0.7905	6.0296	29,000	1.1871	4.8425	269	37,422	269	37,422	0.9639	1.2892	-0.1734	4.7404	.	.	.	.		
		2008-09	10	60,835	1.2870	13.1683	40,000	1.7079	11.4604	.	.	283	36,793	0.9263	1.2274	0.3607	11.9409	.	.	.	.		
		2009-10	3	364	0.0712	0.0834	37,000	1.4812	-1.3978	.	.	296	36,164	0.8947	1.1693	-0.8235	-1.0859	.	.	.	.		
		2010-11	17	3,411	0.3060	1.0439	36,000	1.3373	-0.2934	.	.	296	36,164	0.8947	1.1693	-0.5887	-0.1255	.	.	.	.		
		2011-12	23	2,514	0.4208	0.7115	36,000	1.4452	-0.7337	.	.	310	35,534	0.8676	1.1148	-0.4468	-0.4033	.	.	.	.		
		2012-13	22	2,264	0.3392	0.3505	41,000	1.6148	-1.2643	323	34,905	323	34,905	0.8442	1.0633	-0.5050	-0.7129	.	.	.	.		
		2013-14	22	9,276	0.3059	1.8360	50,000	1.8939	-0.0580	.	.	323	34,905	0.8442	1.0633	-0.5383	0.7726	.	.	.	.		
		2014-15	22	3,617	0.3706	0.8731	48,000	1.7518	-0.8787	.	.	323	34,905	0.8442	1.0633	-0.4736	-0.1902	.	.	.	.		
		2015-16	24	646	0.4192	0.1511	44,000	1.6541	-1.5031	.	.	323	34,905	0.8442	1.0633	-0.4250	-0.9123	44,000	51,000	50,000	55,000	0.0191	-1.7621
		2016-17	24	4,679	0.4816	1.2591	50,000	1.8018	-0.5427	.	.	323	34,905	0.8442	1.0633	-0.3626	0.1957	52,000	54,000	51,000	48,000	0.0158	-0.3240
LA	Louisiana	2007-2017	171	116,385	0.3651	2.6328	411,000	1.5918	1.0410			3,068	356,601	0.8727	1.1254	-0.5076	1.5074	96,000	105,000	101,000	103,000	0.0174	0.8891
ME	Maine	2007-08	6	45,337	1.1858	9.6244	9,000	0.3684	9.2560	311	5,780	311	5,780	1.1144	0.1991	0.0714	9.4253	.	.	.	.		
		2008-09	38	44,971	4.8906	9.7344	7,000	0.2989	9.4355	.	.	348	7,949	1.1395	0.2652	3.7511	9.4692	.	.	.	.		
		2009-10	89	13,945	2.1130	3.1958	6,000	0.2402	2.9556	.	.	384	10,118	1.1607	0.3272	0.9523	2.8686	.	.	.	.		
		2010-11	106	14,614	1.9078	4.4724	5,000	0.1857	4.2866	.	.	384	10,118	1.1607	0.3272	0.7472	4.1452	.	.	.	.		
		2011-12	139	20,812	2.5430	5.8898	4,000	0.1606	5.7292	.	.	421	12,287	1.1788	0.3855	1.3642	5.5043	.	.	.	.		
		2012-13	177	47,851	2.7290	7.4072	4,000	0.1575	7.2496	457	14,456	457	14,456	1.1944	0.4404	1.5345	6.9668	.	.	.	.		
		2013-14	166	29,096	2.3078	5.7588	7,000	0.2652	5.4937	.	.	457	14,456	1.1944	0.4404	1.1134	5.3184	.	.	.	.		
		2014-15	126	18,910	2.1229	4.5647	8,000	0.2920	4.2727	.	.	457	14,456	1.1944	0.4404	0.9279	4.1243	.	.	.	.		

			BIP Surveys					NASS Honey			NASS Census		NASS Census extrapolated						NASS Honey Bee Colonies					
Initials	State	Survey Year	N	Start Colonies	%N	% Start Col.		Honey Producing Col.	% H.p.col.	Col. allotment residuals	All Farms	All Colonies	All Farms	All Colonies	% Farms	% Colonies	Farm allotment residuals	Col. allotment residuals	StartColonies_Apr	StartColonies_Jan	StartColonies_Jul	StartColonies_Oct	%Oct.Col	Oct.Co.Residuals
		2015-16	112	29,967	1.9563	7.0073		10,000	0.3759	6.6314	.	.	457	14,456	1.1944	0.4404	0.7619	6.5669	4,600	3,100	6,000	4,700	0.0016	6.8438
		2016-17	85	30,652	1.7058	8.2481		12,000	0.4324	7.8156	.	.	457	14,456	1.1944	0.4404	0.5114	7.8077	3,600	2,200	5,500	3,500	0.0012	8.1326
ME	Maine	2007-2017	1,044	296,755	2.2288	6.7130		72,000	0.2789	6.4342			4,132	118,532	1.1754	0.3741	1.0535	6.3390	8,200	5,300	11,500	8,200	0.0014	6.5743
MD	Maryland	2007-08	14	4,013	2.7668	0.8408	(P)				319	6,444	319	6,444	1.1430	0.2220	1.6238	0.6188	.	.	.	.		
		2008-09	15	5,931	1.9305	1.2838	(P)				.	.	328	6,806	1.0764	0.2270	0.8541	1.0568	.	.	.	.		
		2009-10	171	4,145	4.0598	0.9499	(P)				.	.	338	7,168	1.0201	0.2318	3.0397	0.7181	.	.	.	.		
		2010-11	172	1,456	3.0958	0.4456	(P)				.	.	338	7,168	1.0201	0.2318	2.0756	0.2138	.	.	.	.		
		2011-12	335	2,187	6.1288	0.6189	(P)				.	.	347	7,530	0.9720	0.2362	5.1568	0.3827	.	.	.	.		
		2012-13	271	11,840	4.1782	1.8328	(P)				356	7,892	356	7,892	0.9305	0.2404	3.2478	1.5924	.	.	.	.		
		2013-14	192	11,871	2.6693	2.3496	(P)				.	.	356	7,892	0.9305	0.2404	1.7388	2.1091	.	.	.	.		
		2014-15	158	10,577	2.6613	2.5532	(P)				.	.	356	7,892	0.9305	0.2404	1.7308	2.3128	.	.	.	.		
		2015-16	154	14,905	2.6900	3.4853	(P)				.	.	356	7,892	0.9305	0.2404	1.7595	3.2449	8,000	7,500	7,000	7,500	0.0026	3.2244
		2016-17	162	4,319	3.2511	1.1622	(P)				.	.	356	7,892	0.9305	0.2404	2.3206	0.9218	8,000	7,500	7,000	7,500	0.0025	0.9148
MD	Maryland	2007-2017	1,644	71,244	3.5097	1.6117	(P)						3,449	74,576	0.9811	0.2354	2.5287	1.3763	16,000	15,000	14,000	15,000	0.0025	1.3577
MA	Massachusetts	2007-08	2	22,500	0.3953	4.7140	(P)				367	8,255	367	8,255	1.3150	0.2844	-0.9198	4.4296	.	.	.	.		
		2008-09	38	20,174	4.8906	4.3669	(P)				.	.	412	7,358	1.3502	0.2454	3.5404	4.1214	.	.	.	.		
		2009-10	193	11,361	4.5821	2.6036	(P)				.	.	457	6,461	1.3798	0.2089	3.2029	2.3947	.	.	.	.		
		2010-11	219	13,550	3.9417	4.1467	(P)				.	.	457	6,461	1.3798	0.2089	2.5619	3.9378	.	.	.	.		
		2011-12	221	12,212	4.0432	3.4560	(P)				.	.	501	5,563	1.4051	0.1745	2.6380	3.2814	.	.	.	.		
		2012-13	245	17,896	3.7774	2.7702	(P)				546	4,666	546	4,666	1.4270	0.1421	2.3509	2.6281	.	.	.	.		
		2013-14	196	10,490	2.7249	2.0762	(P)				.	.	546	4,666	1.4270	0.1421	1.2978	1.9941	.	.	.	.		
		2014-15	195	1,477	3.2845	0.3565	(P)				.	.	546	4,666	1.4270	0.1421	1.8574	0.2144	.	.	.	.		
		2015-16	153	1,272	2.6725	0.2974	(P)				.	.	546	4,666	1.4270	0.1421	1.2454	0.1553	4,100	2,900	7,500	4,500	0.0016	0.1409
		2016-17	113	21,497	2.2677	5.7846	(P)				.	.	546	4,666	1.4270	0.1421	0.8407	5.6424	4,200	3,000	9,500	8,000	0.0026	5.5207
MA	Massachusetts	2007-2017	1,575	132,429	3.3624	2.9958	(P)						4,929	57,427	1.4004	0.1812	1.9621	2.8145	8,300	5,900	17,000	12,500	0.0021	2.7841
MI	Michigan	2007-08	15	6,607	2.9644	1.3943		72,000	2.9472	-1.5629	870	74,362	870	74,362	3.1174	2.5618	-0.1530	-1.1775	.	.	.	.		
		2008-09	21	8,722	2.7027	1.8880		71,000	3.0316	-1.1436	.	.	940	75,520	3.0832	2.5193	-0.3805	-0.6313	.	.	.	.		
		2009-10	231	11,776	5.4843	2.6987		66,000	2.6421	0.0566	.	.	1,011	76,679	3.0543	2.4794	2.4300	0.2193	.	.	.	.		
		2010-11	278	21,212	5.0036	6.4916		71,000	2.6374	3.8541	.	.	1,011	76,679	3.0543	2.4794	1.9499	4.0122	.	.	.	.		
		2011-12	237	9,293	4.3359	2.6299		74,000	2.9707	-0.3408	.	.	1,081	77,837	3.0296	2.4419	1.3063	0.1881	.	.	.	.		
		2012-13	313	23,519	4.8258	3.6407		73,000	2.8751	0.7655	1,151	78,995	1,151	78,995	3.0083	2.4065	1.8175	1.2342	.	.	.	.		
		2013-14	460	24,529	6.3951	4.8537		85,000	3.2197	1.6340	.	.	1,151	78,995	3.0083	2.4065	3.3868	2.4472	.	.	.	.		
		2014-15	284	9,594	4.7836	2.3159		91,000	3.3212	-1.0053	.	.	1,151	78,995	3.0083	2.4065	1.7753	-0.0906	.	.	.	.		
		2015-16	256	4,772	4.4716	1.1159		90,000	3.3835	-2.2676	.	.	1,151	78,995	3.0083	2.4065	1.4633	-1.2906	58,000	16,500	89,000	67,000	0.0233	-1.2148
		2016-17	177	11,816	3.5521	3.1795		89,000	3.2072	-0.0277	.	.	1,151	78,995	3.0083	2.4065	0.5438	0.7730	40,000	25,000	108,000	101,000	0.0333	-0.1515
MI	Michigan	2007-2017	2,272	131,834	4.8505	2.9823		782,000	3.0287	-0.0464			10,667	776,051	3.0343	2.4492	1.8162	0.5331	98,000	41,500	197,000	168,000	0.0284	0.1381
MN	Minnesota	2007-08	0	0	0.0000	0.0000		130,000	5.3213	-5.3213	489	113,448	489	113,448	1.7522	3.9083	-1.7522	-3.9083	.	.	.	.		
		2008-09	4	4,759	0.5148	1.0301		122,000	5.2092	-4.1791	.	.	529	110,442	1.7355	3.6842	-1.2207	-2.6541	.	.	.	.		
		2009-10	37	101,437	0.8784	23.2465		122,000	4.8839	18.3626	.	.	570	107,436	1.7213	3.4739	-0.8429	19.7726	.	.	.	.		
		2010-11	54	101,255	0.9719	30.9873		128,000	4.7548	26.2325	.	.	570	107,436	1.7213	3.4739	-0.7494	27.5134	.	.	.	.		
		2011-12	63	757	1.1526	0.2142		120,000	4.8173	-4.6031	.	.	610	104,430	1.7093	3.2761	-0.5567	-3.0619	.	.	.	.		
		2012-13	117	53,734	1.8039	8.3179		125,000	4.9232	3.3947	650	101,424	650	101,424	1.6989	3.0898	0.1050	5.2281	.	.	.	.		
		2013-14	140	97,604	1.9463	19.3183		130,000	4.9242	14.3940	.	.	650	101,424	1.6989	3.0898	0.2475	16.2285	.	.	.	.		
		2014-15	109	77,361	1.8359	18.6742		132,000	4.8175	13.8567	.	.	650	101,424	1.6989	3.0898	0.1371	15.5844	.	.	.	.		
		2015-16	170	25,014	2.9694	5.8491		122,000	4.5865	1.2627	.	.	650	101,424	1.6989	3.0898	1.2706	2.7594	71,000	28,000	133,000	104,000	0.0362	2.2315
		2016-17	107	13,893	2.1473	3.7384		124,000	4.4685	-0.7300	.	.	650	101,424	1.6989	3.0898	0.4484	0.6487	27,000	36,000	132,000	113,000	0.0373	0.0116
MN	Minnesota	2007-2017	801	475,814	1.7100	10.7637		1,255,000	4.8606	5.9031			6,017	1,050,312	1.7116	3.3147	-0.0015	7.4490	98,000	64,000	265,000	217,000	0.0367	7.0900
MS	Mississippi	2007-08	14	9,145	2.7668	1.9160		15,000	0.6140	1.3020	360	22,032	360	22,032	1.2900	0.7590	1.4768	1.1570	.	.	.	.		
		2008-09	15	18,352	1.9305	3.9725		14,000	0.5978	3.3747	.	.	397	25,548	1.3002	0.8529	0.6303	3.1202	.	.	.	.		
		2009-10	14	11,196	0.3324	2.5658		14,000	0.5604	2.0054	.	.	433	29,065	1.3088	0.9398	-0.9764	1.6260	.	.	.	.		
		2010-11	16	96,053	0.2880	29.3953		16,000	0.5944	28.8010	.	.	433	29,065	1.3088	0.9398	-1.0208	28.4555	.	.	.	.		
		2011-12	13	72,290	0.2378	20.4579		18,000	0.7226	19.7353	.	.	470	32,581	1.3161	1.0221	-1.0783	19.4358	.	.	.	.		
		2012-13	41	89,705	0.6321	13.8861		18,000	0.7089	13.1771	506	36,097	506	36,097	1.3225	1.0997	-0.6904	12.7864	.	.	.	.		
		2013-14	23	85,643	0.3198	16.9509		17,000	0.6439	16.3069	.	.	506	36,097	1.3225	1.0997	-1.0027	15.8512	.	.	.	.		
		2014-15	12	6,123	0.2021	1.4780		20,000	0.7299	0.7481	.	.	506	36,097	1.3225	1.0997	-1.1204	0.3784	.	.	.	.		
		2015-16	15	5,124	0.2620	1.1982		15,000	0.5639	0.6343	.	.	506	36,097	1.3225	1.0997	-1.0605	0.0985	89,000	34,000	23,000	31,000	0.0108	0.1198
		2016-17	9	11,793	0.1806	3.1734		19,000	0.6847	2.4887	.	.	506	36,097	1.3225	1.0997	-1.1419	2.0737	85,000	21,000	19,000	17,500	0.0058	2.5962
MS	Mississippi	2007-2017	172	405,424	0.3672	9.1713		166,000	0.6429	8.5284			4,622	318,775	1.3147	1.0060	-0.9475	8.1653	174,000	55,000	42,000	48,500	0.0082	8.3503
MO	Missouri	2007-08	1	5	0.1976	0.0010		14,000	0.5731	-0.5720	884	21,372	884	21,372	3.1676	0.7363	-2.9699	-0.7352	.	.	.	.		
		2008-09	0	0	0.0000	0.0000		11,000	0.4697	-0.4697	.	.	986	19,669	3.2315	0.6561	-3.2315	-0.6561	.	.	.	.		
		2009-10	42	1,045	0.9972	0.2395		11,000	0.4404	-0.2009	.	.	1,087	17,967	3.2855	0.5809	-2.2884	-0.3415	.	.	.	.		
		2010-11	161	2,350	2.8978	0.7192		11,000	0.4086	0.3106	.	.	1,087	17,967	3.2855	0.5809	-0.3878	0.1382	.	.	.	.		
		2011-12	97	1,454	1.7746	0.4115		8,000	0.3212	0.0903	.	.	1,189	16,264	3.3317	0.5102	-1.5571	-0.0987	.	.	.	.		
		2012-13	104	1,596	1.6035	0.2471		7,000	0.2757	-0.0286	1,290	14,561	1,290	14,561	3.3716	0.4436	-1.7681	-0.1965	.	.	.	.		
		2013-14	97	1,396	1.3485	0.2763		10,000	0.3788	-0.1025	.	.	1,290	14,561	3.3716	0.4436	-2.0230	-0.1673	.	.	.	.		
		2014-15	114	1,823	1.9202	0.4401		12,000	0.4380	0.0021	.	.	1,290	14,561	3.3716	0.4436	-1.4514	-0.0035	.	.	.	.		
		2015-16	138	1,033	2.4105	0.2416		10,000	0.3759	-0.1344	.	.	1,290	14,561	3.3716	0.4436	-0.9611	-0.2020	11,500	12,000	14,000	13,500	0.0047	-0.2281
		2016-17	113	1,086	2.2677	0.2922		8,000	0.2883	0.0039	.	.	1,290	14,561	3.3716	0.4436	-1.1039	-0.1514	12,000	10,000	13,500	9,000	0.0030	-0.0046
MO	Missouri	2007-2017	867	11,788	1.8509	0.2667		102,000	0.3950	-0.1284			11,682	166,043	3.3230	0.5240	-1.4720	-0.2574	29,500	22,000	27,500	22,500	0.0038	-0.1143
MT	Montana	2007-08	13	55,330	2.5692	11.5923		135,000	5.5260	6.0663	170	110,389	170	110,389	0.6091	3.8029	1.9600	7.7894	.	.	.	.		
		2008-09	3	33,500	0.3861	7.2514		134,000	5.7216	1.5298	.	.	183	112,542	0.6001	3.7543	-0.2140	3.4971	.	.	.	.		
		2009-10	24	105,509	0.5698	24.1797		146,000	5.8447	18.3350	.	.	196	114,696	0.5924	3.7086	-0.0226	20.4710	.	.	.	.		
		2010-11	26	41,933	0.4680	12.8328		157,000	5.8321	7.0008	.	.	196	114,696	0.5924	3.7086	-0.1245	9.1242	.	.	.	.		
		2011-12	33	22,862	0.6097	6.4699		145,000	5.8210	0.6490	.	.	209	116,849	0.5859	3.6657	0.0179	2.8042	.	.	.	.		
		2012-13	46	63,014	0.7092	9.7544		145,000	5.7109	4.0435	222	119,002	222	119,002	0.5802	3.6253	0.1290	6.1291	.	.	.	.		
		2013-14	28	28,378	0.3893	5.6167		159,000	6.0227	-0.4060	.	.	222	119,002	0.5802	3.6253	-0.1910	1.9914	.	.	.	.		
		2014-15	31	30,059	0.5221	7.2559		162,000	5.9124	1.3435	.	.	222	119,002	0.5802	3.6253	-0.0581	3.6307	.	.	.	.		
		2015-16	18	39,811	0.3144	9.3092		146,000	5.4887	3.8205	.	.	222	119,002	0.5802	3.6253	-0.2658	5.6839	36,000	8,500	140,000	116,000	0.0404	5.2741
		2016-17	28	38,962	0.5619	10.4842		159,000	5.7297	4.7545	.	.	222	119,002	0.5802	3.6253	-0.0183	6.8589	62,000	16,500	147,000	124,000	0.0409	6.3946
MT	Montana	2007-2017	250	459,358	0.5397	10.3914		1,488,000	5.7630	4.6284			2,064	1,164,181	0.5871	3.6741	-0.0534	6.7173	98,000	25,000	287,000	240,000	0.0406	6.3283
NE	Nebraska	2007-08	1	220	0.1976	0.0461		45,000	1.8420	-1.7959	193	36,666	193	36,666	0.6916	1.2632	-0.4939	-1.2171	.	.	.	.		
		2008-09	1	6,500	0.1287	1.4070		36,000	1.5371	-0.1302	.	.	227	38,723	0.7444	1.2918	-0.6157	0.1152	.	.	.	.		
		2009-10	17	85,286	0.4036	19.5451		48,000	1.9215	17.6236	.	.	261	40,781	0.7889	1.3186	-0.3853	18.2265	.	.	.	.		
		2010-11	16	79,194	0.2880	24.2359		41,000	1.5230	22.7129	.	.	261	40,781	0.7889	1.3186	-0.5009	22.9173	.	.	.	.		
		2011-12	9	9,038	0.1647	2.5577		41,000	1.6459	0.9118	.	.	295	42,838	0.8270	1.3439	-0.6623	1.2139	.	.	.	.		
		2012-13	23	77,173	0.3546	11.9461		43,000	1.6936	10.2526	329	44,895	329	44,895	0.8599	1.3677	-0.5053	10.5785	.	.	.	.		
		2013-14	15	79,297	0.2085	15.6830		46,000	1.7424	13.9406	.	.	329	44,895	0.8599	1.3677	-0.6513	14.3153	.	.	.	.		
		2014-15	15	72,610	0.2527	17.5273		50,000	1.8248	15.7025	.	.	329	44,895	0.8599	1.3677	-0.6072	16.1597	.	.	.	.		
		2015-16	18	26,792	0.3144	6.2649		57,000	2.1429	4.1220	.	.	329	44,895	0.8599	1.3677	-0.5455	4.8972	29,000	10,000	67,000	72,000	0.0250	3.7604
		2016-17	22	215	0.4415	0.0579		48,000	1.7297	-1.6719	.	.	329	44,895	0.8599	1.3677	-0.4184	-1.3098	19,500	11,000	45,000	37,000	0.0122	-1.1624
NE	Nebraska	2007-2017	137	436,265	0.2925	9.8690		455,000	1.7622	8.1068			2,882	424,263	0.8198	1.3980	-0.5273	8.5301	48,500	21,000	112,000	109,000	0.0185	8.0237
NV	Nevada	2007-08	0	0	0.0000	0.0000		10,000	0.4093	-0.4093	30	991	30	991	0.1075	0.0341	-0.1075	-0.0341	.	.	.	.		
		2008-09	0	0	0.0000	0.0000		10,000	0.4270	-0.4270	.	.	48	3,289	0.1574	0.1097	-0.1574	-0.1097	.	.	.	.		
		2009-10	5	1,851	0.1187	0.4242	(P)				.	.	66	5,587	0.1995	0.1806	-0.0808	0.2436	.	.	.	.		
		2010-11	6	3,775	0.1080	1.1553	(P)				.	.	66	5,587	0.1995	0.1806	-0.0915	0.9746	.	.	.	.		
		2011-12	18	1,660	0.3293	0.4698	(P)				.	.	84	7,884	0.2355	0.2473	0.0938	0.2224	.	.	.	.		
		2012-13	11	6,720	0.1696	1.0402	(P)				102	10,182	102	10,182	0.2666	0.3102	-0.0970	0.7301	.	.	.	.		
		2013-14	12	625	0.1668	0.1237	(P)				.	.	102	10,182	0.2666	0.3102	-0.0998	-0.1865	.	.	.	.		
		2014-15	8	1,147	0.1347	0.2769	(P)				.	.	102	10,182	0.2666	0.3102	-0.1318	-0.0333	.	.	.	.		
		2015-16	9	2,261	0.1572	0.5287	(P)				.	.	102	10,182	0.2666	0.3102	-0.1094	0.2185	.	.	.	.		
		2016-17	15	1,688	0.3010	0.4542	(P)				.	.	102	10,182	0.2666	0.3102	0.0344	0.1440	.	.	.	.		
NV	Nevada	2007-2017	84	19,727	0.1793	0.4463	(P)						804	74,247	0.2287	0.2343	-0.0494	0.2119						
NH	New Hampshire	2007-08	0	0	0.0000	0.0000	(P)				184	1,901	184	1,901	0.6593	0.0655	-0.6593	-0.0655	.	.	.	.		
		2008-09	1	3	0.1287	0.0006	(P)				.	.	205	2,154	0.6722	0.0718	-0.5435	-0.0712	.	.	.	.		
		2009-10	76	802	1.8044	0.1838	(P)				.	.	226	2,407	0.6831	0.0778	1.1213	0.1060	.	.	.	.		
		2010-11	84	890	1.5119	0.2724	(P)				.	.	226	2,407	0.6831	0.0778	0.8288	0.1946	.	.	.	.		
		2011-12	63	857	1.1526	0.2425	(P)				.	.	247	2,659	0.6924	0.0834	0.4602	0.1591	.	.	.	.		
		2012-13	96	898	1.4801	0.1390	(P)				268	2,912	268	2,912	0.7005	0.0887	0.7797	0.0503	.	.	.	.		
		2013-14	74	529	1.0288	0.1047	(P)				.	.	268	2,912	0.7005	0.0887	0.3283	0.0160	.	.	.	.		
		2014-15	59	651	0.9938	0.1571	(P)				.	.	268	2,912	0.7005	0.0887	0.2933	0.0684	.	.	.	.		
		2015-16	64	307	1.1179	0.0718	(P)				.	.	268	2,912	0.7005	0.0887	0.4175	-0.0169	.	.	.	.		
		2016-17	59	712	1.1840	0.1916	(P)				.	.	268	2,912	0.7005	0.0887	0.4836	0.1029	.	.	.	.		
NH	New Hampshire	2007-2017	576	5,649	1.2297	0.1278	(P)						2,428	26,087	0.6907	0.0823	0.5390	0.0455						
NJ	New Jersey	2007-08	15	22,622	2.9644	4.7396		9,000	0.3684	4.3712	266	10,926	266	10,926	0.3531	0.3764	2.0113	4.3632	.	.	.	.		

Initials	State	Survey Year	BIP Surveys N	BIP Surveys Start Colonies	BIP Surveys %N	BIP Surveys % Start Col.	NASS Honey Honey Producing Col.	NASS Honey % H.p.col.	NASS Honey Col. allotment residuals	NASS Census All Farms	NASS Census All Colonies	NASS Census extrapolated All Farms	NASS Census extrapolated All Colonies	NASS Census extrapolated % Farms	NASS Census extrapolated % Colonies	NASS Census extrapolated Farm allotment residuals	NASS Census extrapolated Col. allotment residuals	NASS Honey Bee Colonies StartColonies_Apr	NASS Honey Bee Colonies StartColonies_Jan	NASS Honey Bee Colonies StartColonies_Jul	NASS Honey Bee Colonies StartColonies_Oct	NASS Honey Bee Colonies %Oct.Col	NASS Honey Bee Colonies Oct.Co.Residuals
		2008-09	3	25,700	0.3861	5.5630	9,000	0.3843	5.1787	.	.	292	11,519	0.9559	0.3843	-0.5698	5.1787	.	.	.	.		
		2009-10	31	3,046	0.7360	0.6981	11,000	0.4404	0.2577	.	.	317	12,112	0.9582	0.3916	-0.2222	0.3064	.	.	.	.		
		2010-11	110	2,113	1.9798	0.6466	13,000	0.4829	0.1637	.	.	317	12,112	0.9582	0.3916	1.0217	0.2550	.	.	.	.		
		2011-12	72	5,195	1.3172	1.4702	11,000	0.4416	1.0286	.	.	343	12,705	0.9601	0.3986	0.3571	1.0716	.	.	.	.		
		2012-13	87	24,746	1.3414	3.8306	14,000	0.5514	3.2792	368	13,298	368	13,298	0.9618	0.4051	0.3795	3.4255	.	.	.	.		
		2013-14	197	14,714	2.7388	2.9129	11,000	0.4167	2.4956	.	.	368	13,298	0.9618	0.4051	1.7770	2.5072	.	.	.	.		
		2014-15	112	1,295	1.8865	0.3126	12,000	0.4380	-0.1254	.	.	368	13,298	0.9618	0.4051	0.9247	-0.0925	.	.	.	.		
		2015-16	129	8,000	2.2533	1.8707	12,000	0.4511	1.4196	.	.	368	13,298	0.9618	0.4051	1.2915	1.4656	8,500	6,000	18,500	8,000	0.0028	1.5924
		2016-17	83	2,962	1.6657	0.7970	12,000	0.4324	0.3646	.	.	368	13,298	0.9618	0.4051	0.7038	0.3919	4,200	6,000	18,000	12,000	0.0040	0.4013
NJ	New Jersey	2007-2017	839	110,393	1.7912	2.4973	114,000	0.4415	2.0558			3,374	125,864	0.9597	0.3972	0.8314	2.1000	12,700	12,000	36,500	20,000	0.0034	2.1587
NM	New Mexico	2007-08	7	4,850	1.3834	1.0161	6,000	0.2456	0.7705	149	11,511	149	11,511	0.5339	0.3966	0.8495	0.6196	.	.	.	.		
		2008-09	1	2	0.1287	0.0004	6,000	0.2562	-0.2558	.	.	191	12,405	0.6271	0.4138	-0.4984	-0.4134	.	.	.	.		
		2009-10	9	3,034	0.2137	0.6953	7,000	0.2802	0.4151	.	.	234	13,300	0.7058	0.4300	-0.4921	0.2653	.	.	.	.		
		2010-11	24	185	0.4320	0.0566	7,000	0.2600	-0.2034	.	.	234	13,300	0.7058	0.4300	-0.2738	-0.3734	.	.	.	.		
		2011-12	14	214	0.2561	0.0606	7,000	0.2810	-0.2205	.	.	276	14,194	0.7730	0.4453	-0.5169	-0.3847	.	.	.	.		
		2012-13	27	128	0.4163	0.0198	5,000	0.1969	-0.1771	318	15,088	318	15,088	0.8311	0.4596	-0.4149	-0.4398	.	.	.	.		
		2013-14	23	116	0.3198	0.0230	(P)			.	.	318	15,088	0.8311	0.4596	-0.5114	-0.4367	.	.	.	.		
		2014-15	24	1,926	0.4042	0.4649	(P)			.	.	318	15,088	0.8311	0.4596	-0.4269	0.0053	.	.	.	.		
		2015-16	19	199	0.3319	0.0465	(P)			.	.	318	15,088	0.8311	0.4596	-0.4993	-0.4131	6,500	7,000	6,500	6,000	0.0021	-0.1622
		2016-17	25	382	0.5017	0.1028	(P)			.	.	318	15,088	0.8311	0.4596	-0.3294	-0.3568	6,500	6,000	6,500	7,000	0.0023	-0.1281
NM	New Mexico	2007-2017	173	11,036	0.3693	0.2497	(P)					2,673	140,149	0.7603	0.4423	-0.3910	-0.1927	13,000	13,000	13,000	13,000	0.0022	0.0296
NY	New York	2007-08	12	26,950	2.9715	5.6464	53,000	2.1695	3.4769	805	46,401	805	46,401	2.8845	1.5985	-0.5129	4.0478	.	.	.	.		
		2008-09	28	35,182	3.6036	7.6155	50,000	2.1349	5.4806	.	.	896	52,440	2.9372	1.7499	0.6664	5.8661	.	.	.	.		
		2009-10	162	22,154	3.8462	5.0771	45,000	1.8014	3.2756	.	.	987	58,479	2.9818	1.8909	0.8644	3.1862	.	.	.	.		
		2010-11	217	7,912	3.9057	2.4213	45,000	1.6716	0.7497	.	.	987	58,479	2.9818	1.8909	0.9239	0.5304	.	.	.	.		
		2011-12	191	14,102	3.4943	3.9908	49,000	1.9671	2.0238	.	.	1,077	64,518	3.0198	2.0240	0.4745	1.9668	.	.	.	.		
		2012-13	270	46,196	4.1628	7.1510	51,000	2.0087	5.1423	1,168	70,557	1,168	70,557	3.0527	2.1494	1.1101	5.0016	.	.	.	.		
		2013-14	211	20,607	2.9334	4.0786	55,000	2.0833	1.9953	.	.	1,168	70,557	3.0527	2.1494	-0.1193	1.9292	.	.	.	.		
		2014-15	182	26,818	3.0655	6.4736	60,000	2.1898	4.2838	.	.	1,168	70,557	3.0527	2.1494	0.0128	4.3242	.	.	.	.		
		2015-16	189	24,016	3.3013	5.6158	58,000	2.1805	3.4353	.	.	1,168	70,557	3.0527	2.1494	0.2486	3.4669	24,000	27,000	44,000	45,000	0.0157	4.0504
		2016-17	169	19,910	3.3915	5.3575	64,000	2.3063	3.0512	.	.	1,168	70,557	3.0527	2.1494	0.3388	3.2081	31,000	31,000	56,000	48,000	0.0158	3.7745
NY	New York	2007-2017	1,631	243,847	3.4820	5.5162	530,000	2.0527	3.4635			10,591	633,102	3.0126	1.9980	0.4693	3.5185	55,000	58,000	100,000	93,000	0.0157	3.9418
NC	North Carolina	2007-08	16	6,532	3.1621	1.3685	12,000	0.4912	0.8773	1,967	31,768	1,967	31,768	7.0482	1.0944	-3.8861	0.2741	.	.	.	.		
		2008-09	51	7,635	6.5637	1.6527	12,000	0.5124	1.1403	.	.	2,017	29,882	6.6123	0.9968	-0.0486	0.6558	.	.	.	.		
		2009-10	191	3,126	4.5347	0.7164	11,000	0.4404	0.2760	.	.	2,066	27,997	6.2446	0.9053	-1.7100	-0.1889	.	.	.	.		
		2010-11	615	7,423	11.0691	2.2717	13,000	0.4829	1.7888	.	.	2,066	27,997	6.2446	0.9053	4.8245	1.3664	.	.	.	.		
		2011-12	431	3,917	7.8851	1.1085	14,000	0.5620	0.5465	.	.	2,116	26,111	5.9303	0.8191	1.9548	0.2894	.	.	.	.		
		2012-13	415	5,181	6.3984	0.8020	13,000	0.5120	0.2900	2,165	24,225	2,165	24,225	5.6585	0.7380	0.7399	0.0640	.	.	.	.		
		2013-14	292	71,168	4.0595	14.0859	10,000	0.3788	13.7071	.	.	2,165	24,225	5.6585	0.7380	-1.5990	13.3479	.	.	.	.		
		2014-15	301	2,300	5.0699	0.5552	12,000	0.4380	0.1172	.	.	2,165	24,225	5.6585	0.7380	-0.5886	-0.1828	.	.	.	.		
		2015-16	271	9,514	4.7396	2.2247	12,000	0.4511	1.7736	.	.	2,165	24,225	5.6585	0.7380	-0.9249	1.4867	19,500	24,000	24,000	22,000	0.0077	1.4594
		2016-17	291	5,983	4.6858	1.6100	12,000	0.4324	1.1775	.	.	2,165	24,225	5.6585	0.7380	-1.0227	0.8720	29,000	18,500	25,000	25,000	0.0082	0.7854
NC	North Carolina	2007-2017	2,814	122,779	6.0076	2.7775	121,000	0.4686	2.3088			21,056	264,879	5.9895	0.8359	0.0181	1.9415	42,500	42,500	49,000	47,000	0.0080	1.9818
ND	North Dakota	2007-08	18	103,447	3.5573	21.6735	420,000	17.1920	4.4815	173	390,421	173	390,421	0.6199	13.4501	2.9374	8.2233	.	.	.	.		
		2008-09	24	209,297	3.0888	45.3043	400,000	17.0794	28.2249	.	.	170	385,436	0.5566	12.8578	2.5322	32.4466	.	.	.	.		
		2009-10	30	213,327	0.7123	48.8885	450,000	18.0144	30.8741	.	.	167	380,451	0.5033	12.3018	0.2090	36.5868	.	.	.	.		
		2010-11	21	131,159	0.3780	40.1389	510,000	18.9450	21.1939	.	.	167	380,451	0.5033	12.3018	-0.1253	27.8371	.	.	.	.		
		2011-12	12	60,837	0.2195	17.2168	460,000	18.4665	-1.2497	.	.	163	375,465	0.4576	11.7789	-0.2381	5.4379	.	.	.	.		
		2012-13	39	220,230	0.6013	34.0909	480,000	18.9051	15.1858	160	370,480	160	370,480	0.4182	11.2863	0.1831	22.8046	.	.	.	.		
		2013-14	31	150,882	0.4310	29.8639	480,000	18.1818	11.6815	.	.	160	370,480	0.4182	11.2863	0.0128	18.5770	.	.	.	.		
		2014-15	34	199,777	0.5727	48.2242	490,000	17.8832	30.3410	.	.	160	370,480	0.4182	11.2863	0.1545	36.9379	.	.	.	.		
		2015-16	31	171,301	0.5415	40.0562	490,000	18.4211	21.6351	.	.	160	370,480	0.4182	11.2863	0.1233	28.7699	121,000	57,000	460,000	290,000	0.0800	32.0555
		2016-17	21	117,600	0.4214	31.6447	485,000	17.4775	14.1672	.	.	160	370,480	0.4182	11.2863	0.0033	20.3584	110,000	89,000	510,000	385,000	0.1270	18.9471
ND	North Dakota	2007-2017	261	1,577,857	0.5572	35.6937	4,665,000	18.0674	17.6263			1,639	3,764,629	0.4662	11.8810	0.0910	23.8127	231,000	146,000	970,000	615,000	0.1041	25.2820
OH	Ohio	2007-08	9	1,365	1.7787	0.2860	14,000	0.5731	-0.2871	1,782	22,030	1,782	22,030	6.9853	0.7589	-4.6066	-0.4790	.	.	.	.		
		2008-09	9	51	1.1583	0.0110	14,000	0.5978	-0.5867	.	.	1,904	21,872	6.2442	0.7296	-5.0859	-0.7186	.	.	.	.		
		2009-10	203	4,828	4.8196	1.1064	11,000	0.4404	0.6661	.	.	2,027	21,714	6.1252	0.7021	-1.9057	0.4043	.	.	.	.		
		2010-11	242	1,577	4.3557	0.4826	18,000	0.6686	-0.1860	.	.	2,027	21,714	6.1252	0.7021	-1.7696	-0.2195	.	.	.	.		
		2011-12	231	4,714	4.2261	1.3941	15,000	0.6022	0.7319	.	.	2,149	21,556	6.0235	0.6762	-1.7974	0.6578	.	.	.	.		
		2012-13	281	11,989	4.3324	1.8559	18,000	0.7089	1.1469	2,271	21,398	2,271	21,398	5.9855	0.6519	-1.6031	1.2040	.	.	.	.		
		2013-14	486	13,724	6.7566	2.7163	17,000	0.6439	2.0724	.	.	2,271	21,398	5.9855	0.6519	0.8210	2.0645	.	.	.	.		
		2014-15	345	3,387	5.8110	0.8176	15,000	0.5474	0.2701	.	.	2,271	21,398	5.9855	0.6519	-0.1245	0.1657	.	.	.	.		
		2015-16	296	2,933	5.1703	0.6858	17,000	0.6391	0.0467	.	.	2,271	21,398	5.9855	0.6519	-0.7652	0.0340	17,500	18,000	23,000	19,000	0.0066	0.0249
		2016-17	284	2,280	5.6994	0.6135	15,000	0.5405	0.0730	.	.	2,271	21,398	5.9855	0.6519	-0.2362	-0.0383	14,000	16,500	21,000	19,500	0.0064	-0.0296
OH	Ohio	2007-2017	2,386	46,848	5.0938	1.0598	154,000	0.5964	0.4633			21,243	215,876	6.0427	0.6813	-0.9488	0.3785	31,500	34,500	44,000	38,500	0.0065	0.4080
OK	Oklahoma	2007-08	0	0	0.0000	0.0000	(P)			544	6,457	544	6,457	1.9499	0.2224	-1.9499	-0.2224	.	.	.	.		
		2008-09	0	0	0.0000	0.0000	(P)			.	.	567	10,096	1.8601	0.3368	-1.8601	-0.3368	.	.	.	.		
		2009-10	10	139	0.2374	0.0319	(P)			.	.	591	13,734	1.7848	0.4441	-1.5474	-0.4122	.	.	.	.		
		2010-11	31	628	0.5580	0.1922	(P)			.	.	591	13,734	1.7848	0.4441	-1.2269	-0.2519	.	.	.	.		
		2011-12	28	158	0.5123	0.0447	(P)			.	.	614	17,373	1.7205	0.5450	-1.2082	-0.5003	.	.	.	.		
		2012-13	37	3,389	0.5705	0.5246	(P)			637	21,011	637	21,011	1.6649	0.6401	-1.0944	-0.1155	.	.	.	.		
		2013-14	34	6,551	0.4727	1.2966	(P)			.	.	637	21,011	1.6649	0.6401	-1.1922	0.6565	.	.	.	.		
		2014-15	40	5,880	0.6737	1.4194	(P)			.	.	637	21,011	1.6649	0.6401	-0.9911	0.7793	.	.	.	.		
		2015-16	46	4,352	0.8035	1.0176	(P)			.	.	637	21,011	1.6649	0.6401	-0.8614	0.3776	25,000	9,500	19,500	5,000	0.0017	0.8437
		2016-17	34	2,070	0.6823	0.5570	(P)			.	.	637	21,011	1.6649	0.6401	-0.9826	-0.0831	12,000	13,500	3,700	3,100	0.0010	0.4548
OK	Oklahoma	2007-2017	260	23,167	0.5551	0.5241	(P)					6,091	166,448	1.7326	0.5253	-1.1775	-0.0012	37,000	23,000	23,200	8,100	0.0014	0.3869
OR	Oregon	2007-08	1	4,900	0.1976	1.0266	46,000	1.8829	-0.8563	727	52,688	727	52,688	2.6050	1.8151	-2.4074	-0.7885	.	.	.	.		
		2008-09	1	3,500	0.1287	0.7576	50,000	2.1349	-1.3773	.	.	800	60,064	2.6241	2.0037	-2.4954	-1.2460	.	.	.	.		
		2009-10	49	27,497	1.1633	6.3015	55,000	2.2018	4.0998	.	.	874	67,439	2.6402	2.1806	-1.4769	4.1209	.	.	.	.		
		2010-11	178	19,611	3.2037	6.0016	59,000	2.1917	3.8099	.	.	874	67,439	2.6402	2.1806	0.5635	3.8210	.	.	.	.		
		2011-12	144	36,105	2.6345	10.2177	60,000	2.4087	7.8090	.	.	947	74,815	2.6540	2.3470	-0.0195	7.8706	.	.	.	.		
		2012-13	194	37,938	2.9911	5.8727	60,000	2.3631	3.5095	1,020	82,190	1,020	82,190	2.6659	2.5038	0.3252	3.3689	.	.	.	.		
		2013-14	222	50,691	3.0863	10.0330	62,000	2.3485	7.6845	.	.	1,020	82,190	2.6659	2.5038	0.4204	7.5292	.	.	.	.		
		2014-15	177	38,036	2.9813	9.1815	71,000	2.5912	6.5903	.	.	1,020	82,190	2.6659	2.5038	0.3154	6.6777	.	.	.	.		
		2015-16	159	31,555	2.7773	7.3787	71,000	2.6692	4.7095	.	.	1,020	82,190	2.6659	2.5038	0.1114	4.8748	82,000	77,000	68,000	100,000	0.0348	3.9001
		2016-17	170	37,559	3.4116	10.1067	74,000	2.6667	7.4400	.	.	1,020	82,190	2.6659	2.5038	0.7457	7.6028	77,000	68,000	107,000	98,000	0.0323	6.8745
OR	Oregon	2007-2017	1,295	287,392	2.7647	6.5013	608,000	2.3548	4.1465			9,321	733,394	2.6514	2.3146	0.1133	4.1867	159,000	145,000	175,000	198,000	0.0335	3.1492
PA	Pennsylvania	2007-08	192	15,974	37.9447	3.3468	25,000	1.0233	2.3234	1,346	35,979	1,346	35,979	4.8230	1.2395	33.1217	2.1073	.	.	.	.		
		2008-09	262	11,744	33.7194	2.5421	23,000	0.9821	1.5600	.	.	1,392	34,990	4.5637	1.1672	29.1558	1.3749	.	.	.	.		
		2009-10	546	8,843	12.9630	2.0266	21,000	0.8407	1.1859	.	.	1,438	34,001	4.3449	1.0994	8.6180	0.9272	.	.	.	.		
		2010-11	430	7,150	7.7394	2.1881	30,000	1.1144	1.0737	.	.	1,438	34,001	4.3449	1.0994	3.3944	1.0887	.	.	.	.		
		2011-12	703	11,357	12.8613	3.2140	24,000	0.9635	2.2505	.	.	1,483	33,012	4.1579	1.0356	8.7034	2.1784	.	.	.	.		
		2012-13	565	25,443	8.7111	3.9385	16,000	0.6302	3.3083	1,529	32,023	1,529	32,023	3.9962	0.9755	4.7148	2.9629	.	.	.	.		
		2013-14	1,081	23,126	15.0285	4.5772	13,000	0.4924	4.0848	.	.	1,529	32,023	3.9962	0.9755	11.0323	3.6017	.	.	.	.		
		2014-15	860	24,766	14.4854	5.9783	17,000	0.6204	5.3578	.	.	1,529	32,023	3.9962	0.9755	10.4892	5.0027	.	.	.	.		
		2015-16	777	15,198	13.5721	3.5538	17,000	0.6391	2.9147	.	.	1,529	32,023	3.9962	0.9755	9.5758	2.5783	15,500	14,000	25,000	22,000	0.0077	2.7885
		2016-17	754	11,794	15.1314	3.1736	19,000	0.6847	2.4889	.	.	1,529	32,023	3.9962	0.9755	11.1352	2.1981	11,000	12,500	19,000	21,000	0.0069	2.4810
PA	Pennsylvania	2007-2017	6,170	155,395	13.1722	3.5153	205,000	0.7940	2.7213			14,741	332,098	4.1931	1.0481	8.9791	2.4672	26,500	26,500	44,000	43,000	0.0073	2.7873
PR	Puerto Rico	2007-08	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
		2008-09	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
		2009-10	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
		2010-11	1	13	0.0180	0.0040	(P)			.	.	.	.					.	.	.	.		
		2011-12	1	14	0.0183	0.0040	(P)			.	.	.	.					.	.	.	.		
		2012-13	1	126	0.0154	0.0195	(P)			.	.	.	.					.	.	.	.		
		2013-14	1	80	0.0139	0.0158	(P)			.	.	.	.					.	.	.	.		
		2014-15	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
		2015-16	1	1	0.0175	0.0002	(P)			.	.	.	.					.	.	.	.		
		2016-17	0	0	0.0000	0.0000	(P)			.	.	.	.					.	.	.	.		
PR	Puerto Rico	2007-2017	5	234	0.0107	0.0053	(P)					.	.										
RI	Rhode Island	2007-08	0	0	0.0000	0.0000	(P)			45	419	45	419	0.1612	0.0144	-0.1612	-0.0144	.	.	.	.		
		2008-09	5	30	0.6435	0.0065	(P)			.	.	64	499	0.2099	0.0166	0.4336	-0.0102	.	.	.	.		
		2009-10	67	262	1.5907	0.0600	(P)			.	.	83	579	0.2509	0.0187	1.3398	0.0413	.	.	.	.		
		2010-11	66	214	1.1879	0.0655	(P)			.	.	83	579	0.2509	0.0187	0.9370	0.0468	.	.	.	.		
		2011-12	31	152	0.5671	0.0430	(P)			.	.	102	659	0.2859	0.0207	0.2812	0.0229	.	.	.	.		

Initials	State	Survey Year	BIP Surveys N	Start Colonies	%N	% Start Col.	NASS Honey: Honey Producing Col.	% H.p.col.	Col. allotment residuals	NASS Census: All Farms	All Colonies	NASS Census extrapolated: All Farms	All Colonies	% Farms	% Colonies	Farm allotment residuals	Col. allotment residuals	NASS Honey Bee Colonies: StartColonies_Apr	StartColonies_Jan	StartColonies_Jul	StartColonies_Oct	%Oct.Col	Oct.Co.Residuals
		2012-13	28	205	0.4317	0.0317	(P)			121	739	121	739	0.3162	0.0225	0.1155	0.0092	.	.	.			
		2013-14	24	205	0.3337	0.0406	(P)			.		121	739	0.3162	0.0225	0.0174	0.0181	.	.	.			
		2014-15	26	397	0.4379	0.0958	(P)			.		121	739	0.3162	0.0225	0.1217	0.0730	.	.	.			
		2015-16	24	108	0.4192	0.0253	(P)			.		121	739	0.3162	0.0225	0.1030	0.0027	.	.	.			
		2016-17	19	74	0.3813	0.0199	(P)			.		121	739	0.3162	0.0225	0.0650	-0.0026	.	.	.			
RI	Rhode Island	2007-2017	290	1,647	0.6191	0.0373	(P)					982	6,430	0.2793	0.0203	0.3398	0.0170						
SC	South Carolina	2007-08	5	5,530	0.9881	1.1712	(P)			457	7,009	457	7,009	1.6375	0.2415	-0.6494	0.9297	.	.	.			
		2008-09	1	3	0.1287	0.0006	(P)			.		555	7,778	1.8191	0.2594	-1.6904	-0.2588	.	.	.			
		2009-10	126	9,819	2.9915	2.2502	(P)			.		653	8,546	1.9722	0.2769	1.0192	1.9739	.	.	.			
		2010-11	82	2,757	1.4759	0.6437	(P)			.		653	8,546	1.9722	0.2769	-0.4963	0.5674	.	.	.			
		2011-12	86	5,926	1.5734	1.6770	(P)			.		750	9,315	2.1031	0.2922	-0.5298	1.3848	.	.	.			
		2012-13	97	4,097	1.4955	0.6342	(P)			848	10,083	848	10,083	2.2164	0.3072	-0.7208	0.3270	.	.	.			
		2013-14	155	2,313	2.1549	0.4578	(P)			.		848	10,083	2.2164	0.3072	-0.0615	0.1506	.	.	.			
		2014-15	79	2,061	1.3306	0.4975	9,000	0.3285	0.1690	.		848	10,083	2.2164	0.3072	-0.8857	0.1909	.	.	.			
		2015-16	107	1,772	1.8690	0.4144	14,000	0.5263	-0.1120	.		848	10,083	2.2164	0.3072	-0.3474	0.1072	17,500	17,000	12,000	10,000	0.0035	0.0665
		2016-17	57	2,259	1.1439	0.6063	16,000	0.5766	0.0297	.		848	10,083	2.2164	0.3072	-1.0725	0.2991	12,500	16,500	13,000	12,000	0.0040	0.2105
SC	South Carolina	2007-2017	795	36,591	1.6972	0.8277	(P)					7,307	91,608	2.0785	0.2891	-0.3813	0.5386	30,000	33,500	25,000	22,000	0.0037	0.4553
SD	South Dakota	2007-08	18	99,011	3.5573	20.7441	255,000	10.4380	10.3061	134	230,075	134	230,075	0.4801	7.9262	3.0772	12.8179	.	.	.			
		2008-09	27	162,597	3.4749	35.1957	225,000	9.6072	25.5885	.		144	225,168	0.4714	7.5114	3.0035	27.6843	.	.	.			
		2009-10	16	143,276	0.3799	32.8348	270,000	10.8086	22.0262	.		154	220,261	0.4640	7.1221	-0.0841	25.7127	.	.	.			
		2010-11	18	78,217	0.3240	23.9369	265,000	9.8440	14.0929	.		154	220,261	0.4640	7.1221	-0.1400	16.8148	.	.	.			
		2011-12	7	28,448	0.1281	8.0507	250,000	10.0361	-1.9854	.		163	215,354	0.4576	6.7560	-0.3296	1.2948	.	.	.			
		2012-13	8	77,790	0.1233	12.0416	260,000	10.2403	1.8014	173	210,447	173	210,447	0.4522	6.4110	-0.3288	5.6306	.	.	.			
		2013-14	17	80,228	0.2363	15.8791	265,000	10.0379	5.8412	.		173	210,447	0.4522	6.4110	-0.2158	9.4681	.	.	.			
		2014-15	16	76,136	0.2695	18.3705	280,000	10.2190	8.1515	.		173	210,447	0.4522	6.4110	-0.1827	11.9674	.	.	.			
		2015-16	16	63,677	0.2795	14.8899	290,000	10.9023	3.9877	.		173	210,447	0.4522	6.4110	-0.1727	8.4789	100,000	50,000	295,000	194,000	0.0675	8.1415
		2016-17	13	21,487	0.2609	5.7819	280,000	10.0901	-4.3082	.		173	210,447	0.4522	6.4110	-0.1913	-0.6292	51,000	47,000	178,000	146,000	0.0482	0.9667
SD	South Dakota	2007-2017	156	830,867	0.3390	18.7956	2,640,000	10.2246	8.5709			1,613	2,163,354	0.4588	6.8274	-0.1258	11.9681	151,000	97,000	473,000	340,000	0.0576	13.0995
TN	Tennessee	2007-08	8	516	1.5810	0.1081	7,000	0.2865	-0.1784	1,458	12,614	1,458	12,614	5.2243	0.4346	-3.6433	-0.3264	.	.	.			
		2008-09	7	42	0.9009	0.0091	7,000	0.2989	-0.2898	.		1,529	13,001	5.0146	0.4397	-4.1137	-0.4246	.	.	.			
		2009-10	62	661	1.4720	0.1515	7,000	0.2802	-0.1287	.		1,601	13,388	4.8376	0.4329	-3.3656	-0.2814	.	.	.			
		2010-11	90	691	1.6199	0.2115	8,000	0.2972	-0.0857	.		1,601	13,388	4.8376	0.4329	-3.2177	-0.2214	.	.	.			
		2011-12	102	1,246	1.8661	0.3526	7,000	0.2810	0.0716	.	.	1,672	13,774	4.6864	0.4321	-2.8203	-0.0795	.	.	.			
		2012-13	94	1,280	1.4493	0.1981	6,000	0.2363	-0.0382	1,743	14,161	1,743	14,161	4.5556	0.4314	-3.1063	-0.2333	.	.	.			
		2013-14	102	1,066	1.4180	0.2110	7,000	0.2652	-0.0542	.	.	1,743	14,161	4.5556	0.4314	-3.1375	-0.2204	.	.	.			
		2014-15	82	1,223	1.3812	0.2952	7,000	0.2555	0.0397	.	.	1,743	14,161	4.5556	0.4314	-3.1744	-0.1362	.	.	.			
		2015-16	113	1,495	1.9738	0.3496	7,000	0.2632	0.0864	.	.	1,743	14,161	4.5556	0.4314	-2.5818	-0.0818	7,500	9,500	10,000	8,500	0.0030	0.0539
		2016-17	66	821	1.3245	0.2209	6,000	0.2162	0.0047	.	.	1,743	14,161	4.5556	0.4314	-3.2310	-0.2105	8,000	9,000	10,000	9,000	0.0030	-0.0759
TN	Tennessee	2007-2017	726	9,041	1.5499	0.2045	69,000	0.2672	-0.0627			16,575	136,969	4.7148	0.4323	-3.1649	-0.2277	15,500	18,500	20,000	17,500	0.0030	-0.0917
TX	Texas	2007-08	9	52,800	1.7787	11.0623	105,000	4.2980	6.7643	1,284	128,064	1,284	128,064	4.6008	4.4118	-2.8222	6.6504	.	.	.			
		2008-09	11	49,401	1.4157	10.6933	77,000	3.2878	7.4055	.	.	1,426	130,256	4.6752	4.3452	-3.2595	6.3481	.	.	.			
		2009-10	59	50,739	1.4008	11.6279	89,000	3.5629	8.0651	.	.	1,568	132,447	4.7379	4.2826	-3.3371	7.3453	.	.	.			
		2010-11	76	112,874	1.3679	34.5431	100,000	3.7147	30.8284	.	.	1,568	132,447	4.7379	4.2826	-3.3700	30.2604	.	.	.			
		2011-12	48	78,694	0.8782	22.2703	78,000	3.1313	19.1390	.	.	1,709	134,639	4.7915	4.2238	-3.9133	18.0465	.	.	.			
		2012-13	77	80,014	1.1872	12.3859	92,000	3.6235	8.7624	1,851	136,830	1,851	136,830	4.8378	4.1684	-3.6507	8.2175	.	.	.			
		2013-14	82	125,685	1.1400	24.8762	106,000	4.0152	20.8610	.	.	1,851	136,830	4.8378	4.1684	-3.6978	20.7078	.	.	.			
		2014-15	157	109,746	2.6444	26.4916	116,000	4.2336	22.2580	.	.	1,851	136,830	4.8378	4.1684	-2.1934	22.3232	.	.	.			
		2015-16	99	107,590	1.7293	25.1583	126,000	4.7368	20.4215	.	.	1,851	136,830	4.8378	4.1684	-3.1086	20.9899	305,000	191,000	76,000	125,000	0.0435	20.8101
		2016-17	146	40,602	2.9300	10.9255	133,000	4.7928	6.1927	.	.	1,851	136,830	4.8378	4.1684	-1.9079	6.7571	340,000	240,000	129,000	136,000	0.0449	6.4401
TX	Texas	2007-2017	764	808,145	1.6310	18.2816	1,022,000	3.9582	14.3294			16,809	1,342,002	4.7814	4.2353	-3.1503	14.0463	645,000	431,000	205,000	261,000	0.0442	13.8629
UT	Utah	2007-08	28	17,709	5.5336	3.7103	28,000	1.1461	2.5641	239	28,778	239	28,778	0.8564	0.9914	4.6772	2.7188	.	.	.			
		2008-09	27	18,921	3.4749	4.0956	28,000	1.1956	2.9001	.	.	286	28,104	0.9362	0.9375	2.5387	3.1581	.	.	.			
		2009-10	64	7,768	1.5195	1.7802	26,000	1.0408	0.7394	.	.	332	27,431	1.0035	0.8870	0.5160	0.8932	.	.	.			
		2010-11	117	4,779	2.1058	1.4625	26,000	0.9658	0.4967	.	.	332	27,431	1.0035	0.8870	1.1023	0.5756	.	.	.			
		2011-12	85	4,962	1.5551	1.4042	23,000	0.9233	0.4809	.	.	379	26,757	1.0610	0.8394	0.4940	0.5648	.	.	.			
		2012-13	80	12,897	1.2394	1.9964	25,000	0.9846	1.0118	425	26,083	425	26,083	1.1108	0.7946	0.1226	1.2018	.	.	.			
		2013-14	61	9,250	0.8480	1.8308	30,000	1.1364	0.6944	.	.	425	26,083	1.1108	0.7946	-0.2627	1.0362	.	.	.			
		2014-15	47	16,677	0.7916	4.0257	29,000	1.0584	2.9673	.	.	425	26,083	1.1108	0.7946	-0.3191	3.2311	.	.	.			
		2015-16	46	9,891	0.8035	2.3129	27,000	1.0150	1.2978	.	.	425	26,083	1.1108	0.7946	-0.3073	1.5183	24,000	6,000	31,000	28,000	0.0097	1.3389
		2016-17	292	2,763	4.6558	0.7435	31,000	1.1171	-0.3736	.	.	425	26,083	1.1108	0.7946	3.5450	-0.0511	14,500	12,000	27,000	30,000	0.0099	-0.2459
UT	Utah	2007-2017	787	105,617	1.6802	2.3892	273,000	1.0573	1.3319			3,692	268,915	1.0502	0.8487	0.6299	1.5405	38,500	18,000	58,000	58,000	0.0098	1.4073
VT	Vermont	2007-08	1	1,400	0.1976	0.2933	5,000	0.2047	0.0887	276	7,632	276	7,632	0.9890	0.2629	-0.7913	0.0304	.	.	.			
		2008-09	2	1,503	0.2574	0.3253	5,000	0.2135	0.1118	.	.	321	7,880	1.0509	0.2629	-0.7935	0.0625	.	.	.			
		2009-10	68	2,648	1.6144	0.6068	5,000	0.2002	0.4067	.	.	365	8,128	1.1032	0.2628	0.5112	0.3440	.	.	.			
		2010-11	119	1,551	2.1418	0.4747	4,000	0.1486	0.3261	.	.	365	8,128	1.1032	0.2628	1.0386	0.2118	.	.	.			
		2011-12	89	1,923	1.6282	0.5442	4,000	0.1606	0.3836	.	.	410	8,376	1.1479	0.2628	0.4803	0.2814	.	.	.			
		2012-13	76	4,152	1.1718	0.6427	4,000	0.1575	0.4852	454	8,624	454	8,624	1.1866	0.2627	-0.0148	0.3800	.	.	.			
		2013-14	104	1,696	1.4459	0.3057	3,000	0.1136	0.2220	.	.	454	8,624	1.1866	0.2627	0.2599	0.0730	.	.	.			
		2014-15	67	707	1.1285	0.1707	3,000	0.1095	0.0612	.	.	454	8,624	1.1866	0.2627	-0.0581	-0.0921	.	.	.			
		2015-16	58	2,242	1.0131	0.5243	5,000	0.1880	0.3363	.	.	454	8,624	1.1866	0.2627	-0.1735	0.2615	6,000	5,500	6,000	6,500	0.0023	0.2982
		2016-17	52	1,710	1.0435	0.4601	6,000	0.2162	0.2439	.	.	454	8,624	1.1866	0.2627	-0.1430	0.1974	5,000	5,500	6,500	6,500	0.0021	0.2458
VT	Vermont	2007-2017	636	19,532	1.3578	0.4418	44,000	0.1704	0.2714			4,006	83,264	1.1395	0.2628	0.2183	0.1791	11,000	11,000	12,500	13,000	0.0022	0.2218
VA	Virginia	2007-08	1	1,225	0.1976	0.2567	6,000	0.2456	0.0111	1,020	10,822	1,020	10,822	3.6549	0.3728	-3.4572	-0.1162	.	.	.			
		2008-09	36	161	4.6332	0.0348	6,000	0.2562	-0.2213	.	.	1,217	11,700	3.9890	0.3903	0.6442	-0.3555	.	.	.			
		2009-10	480	3,181	11.3960	0.7290	6,000	0.2402	0.4888	.	.	1,413	12,578	4.2709	0.4067	7.1251	0.3223	.	.	.			
		2010-11	406	4,145	7.3074	1.2685	5,000	0.1857	1.0828	.	.	1,413	12,578	4.2709	0.4067	3.0365	0.8618	.	.	.			
		2011-12	533	3,343	9.7512	0.9461	4,000	0.1606	0.7855	.	.	1,610	13,456	4.5118	0.4221	5.2393	0.5239	.	.	.			
		2012-13	699	14,752	10.7771	2.2836	4,000	0.1575	2.1260	1,806	14,334	1,806	14,334	4.7202	0.4367	6.0568	1.8469	.	.	.			
		2013-14	796	15,726	11.0663	3.1126	5,000	0.1894	2.9232	.	.	1,806	14,334	4.7202	0.4367	6.3461	2.6759	.	.	.			
		2014-15	722	5,365	12.1610	1.2951	6,000	0.2190	1.0761	.	.	1,806	14,334	4.7202	0.4367	7.4408	0.8584	.	.	.			
		2015-16	692	4,019	12.0873	0.9398	6,000	0.2256	0.7142	.	.	1,806	14,334	4.7202	0.4367	7.3671	0.5031	7,500	8,000	8,000	7,500	0.0026	0.6789
		2016-17	444	2,887	8.9103	0.7769	5,000	0.1802	0.5967	.	.	1,806	14,334	4.7202	0.4367	4.1901	0.3402	6,000	6,500	8,000	7,000	0.0023	0.5460
VA	Virginia	2007-2017	4,809	54,804	10.2666	1.2398	53,000	0.2053	1.0345			15,702	132,804	4.4665	0.4191	5.8002	0.8206	13,500	14,500	16,000	14,500	0.0025	0.9943
WA	Washington	2007-08	5	21,870	0.9881	4.5820	46,000	1.8829	2.6991	872	83,170	872	83,170	3.1246	2.8852	-2.1364	1.7168	.	.	.			
		2008-09	8	43,708	1.0296	9.4610	49,000	2.0922	7.3688	.	.	917	86,549	3.0061	2.8872	-1.9765	6.5738	.	.	.			
		2009-10	144	69,351	3.4188	15.8933	62,000	2.4820	13.4113	.	.	962	89,928	2.9062	2.9078	0.5126	12.9855	.	.	.			
		2010-11	150	23,991	2.6998	7.3420	71,000	2.6374	4.7046	.	.	962	89,928	2.9062	2.9078	-0.2064	4.4342	.	.	.			
		2011-12	130	45,444	2.3783	12.8606	71,000	2.8503	10.0103	.	.	1,006	93,306	2.8208	2.9272	-0.4424	9.9334	.	.	.			
		2012-13	178	69,593	2.7444	10.7728	62,000	2.4419	8.3309	1,051	96,685	1,051	96,685	2.7469	2.9454	-0.0025	7.8274	.	.	.			
		2013-14	161	74,378	2.2383	14.7213	69,000	2.6136	12.1076	.	.	1,051	96,685	2.7469	2.9454	-0.5086	11.7759	.	.	.			
		2014-15	158	107,980	2.6613	26.0653	68,000	2.4818	23.5836	.	.	1,051	96,685	2.7469	2.9454	-0.0856	23.1199	.	.	.			
		2015-16	136	28,783	2.3755	6.7305	73,000	2.7444	3.9861	.	.	1,051	96,685	2.7469	2.9454	-0.3714	3.7851	105,000	52,000	84,000	87,000	0.0303	3.7041
		2016-17	113	73,349	2.2677	19.7373	84,000	3.0270	16.7103	.	.	1,051	96,685	2.7469	2.9454	-0.4792	16.7919	91,000	77,000	57,000	65,000	0.0214	17.5936
WA	Washington	2007-2017	1,183	558,447	2.5256	12.6330	655,000	2.5368	10.0962			9,973	926,305	2.8869	2.9234	-0.3113	9.7096	196,000	129,000	141,000	152,000	0.0257	10.0597
WV	West Virginia	2007-08	17	3,399	3.3597	0.7121	6,000	0.2456	0.4665	910	10,701	910	10,701	3.2607	0.3687	0.0990	0.3435	.	.	.			
		2008-09	2	56	0.2574	0.0121	6,000	0.2562	-0.2441	.	.	912	10,357	2.9914	0.3455	-2.7340	-0.3334	.	.	.			
		2009-10	117	1,390	2.7778	0.3185	5,000	0.2002	0.1184	.	.	915	10,013	2.7641	0.3238	0.0136	-0.0052	.	.	.			
		2010-11	56	559	1.0079	0.1711	5,000	0.1857	-0.0147	.	.	915	10,013	2.7641	0.3238	-1.7562	-0.1527	.	.	.			
		2011-12	51	826	0.9330	0.2338	4,000	0.1606	0.0732	.	.	917	9,669	2.5699	0.3033	-1.6368	-0.0696	.	.	.			
		2012-13	86	2,562	1.3259	0.3966	6,000	0.2363	0.1603	919	9,325	919	9,325	2.4019	0.2841	-1.0760	0.1125	.	.	.			
		2013-14	75	1,125	1.0427	0.2227	6,000	0.2273	-0.0046	.	.	919	9,325	2.4019	0.2841	-1.3592	-0.0614	.	.	.			
		2014-15	54	829	0.9096	0.2001	6,000	0.2190	-0.0189	.	.	919	9,325	2.4019	0.2841	-1.4924	-0.0840	.	.	.			
		2015-16	63	1,270	1.1004	0.2970	5,000	0.1880	0.1090	.	.	919	9,325	2.4019	0.2841	-1.3015	0.0129	4,700	4,700	7,000	7,000	0.0024	0.0536
		2016-17	60	875	1.2041	0.2355	5,000	0.1802	0.0553	.	.	919	9,325	2.4019	0.2841	-1.1978	-0.0486	7,000	6,500	7,500	7,500	0.0025	-0.0119
WV	West Virginia	2007-2017	581	12,891	1.2404	0.2916	54,000	0.2091	0.0825			9,163	97,378	2.6064	0.3073	-1.3661	-0.0157	11,700	11,200	14,500	14,500	0.0025	0.0461
WI	Wisconsin	2007-08	15	6,122	2.9644	1.2826	60,000	2.4560	-1.1734	828	47,488	828	47,488	2.9669	1.6360	-0.0025	-0.3533	.	.	.			
		2008-09	17	3,871	2.1879	0.8379	58,000	2.4765	-1.6386	.	.	913	48,031	2.9990	1.6029	-0.8051	-0.7644	.	.	.			
		2009-10	155	12,097	3.6800	2.7723	63,000	2.5220	0.2503	.	.	998	48,575	3.0150	1.5706	0.6650	1.2016	.	.	.			
		2010-11	126	2,904	2.2678	0.8887	64,000	2.3774	-1.4887	.	.	998	48,575	3.0150	1.5706	-0.7472	-0.6819	.	.	.			
		2011-12	138	1,594	2.5247	0.4511	57,000	2.2882	-1.8371	.	.	1,082	49,118	3.0398	1.5409	-0.5091	-1.0898	.	.	.			
		2012-13	184	20,854	2.8369	3.2281	60,000	2.3631	0.8650	1,167	49,661	1,167	49,661	3.0501	1.5129	-0.2132	1.7153	.	.	.			
		2013-14	183	36,244	2.5441	7.1736	59,000	2.2348	4.9387	.	.	1,167	49,661	3.0501	1.5129	-0.5060	5.6607	.	.	.			
		2014-15	161	21,404	2.7118	5.1667	53,000	1.9343	3.2324	.	.	1,167	49,661	3.0501	1.5129	-0.3383	3.6538	.	.	.			
		2015-16	165	19,808	2.8821	4.6318	52,000	1.9549	2.6769	.	.	1,167	49,661	3.0501	1.5129	-0.1680	3.1189	25,000	16,500	60,000	48,000	0.0167	2.9621

Initials	State	Survey Year	BIP Surveys N	Start Colonies	%N	% Start Col.	NASS Honey Honey Producing Col.	% H.p.col.	Col. allotment residuals	NASS Census All Farms	All Colonies	NASS Census extrapolated All Farms	All Colonies	% Farms	% Colonies	Farm allotment residuals	Col. allotment residuals	NASS Honey Bee Colonies StartColonies_Apr	StartColonies_Jan	StartColonies_Jul	StartColonies_Oct	%Oct.Col	Oct.Co.Residuals
		2016-17	140	13,991	2.8096	3.7648	54,000	1.9459	1.8189	.	.	1,167	49,661	3.0501	1.5129	-0.2406	2.2519	18,500	20,000	71,000	59,000	0.0195	1.8189
WI	Wisconsin	2007-2017	1,284	138,889	2.7412	3.1419	580,000	2.2463	0.8956			10,653	490,091	3.0303	1.5467	-0.2891	1.5952	43,500	36,500	131,000	107,000	0.0181	1.3304
WY	Wyoming	2007-08	0	0	0.0000	0.0000	43,000	1.7601	-1.7601	82	45,633	82	45,633	0.2938	1.5721	-0.2938	-1.5721	.	.	.	.		
		2008-09	0	0	0.0000	0.0000	39,000	1.6652	-1.6652	.	.	87	45,482	0.2853	1.5172	-0.2853	-1.5172	.	.	.	.		
		2009-10	4	14,015	0.0950	3.2118	37,000	1.4812	1.7307	.	.	92	45,331	0.2781	1.4658	-0.1831	1.7461	.	.	.	.		
		2010-11	8	3,481	0.1440	1.0653	34,000	1.2630	-0.1977	.	.	92	45,331	0.2781	1.4658	-0.1341	-0.4005	.	.	.	.		
		2011-12	6	3,372	0.1098	0.9543	35,000	1.4051	-0.4508	.	.	97	45,180	0.2719	1.4174	-0.1621	-0.4631	.	.	.	.		
		2012-13	21	16,355	0.3238	2.5317	50,000	1.9693	0.5624	102	45,029	102	45,029	0.2666	1.3718	0.0572	1.1599	.	.	.	.		
		2013-14	11	20,661	0.1529	4.0893	47,000	1.7803	2.3090	.	.	102	45,029	0.2666	1.3718	-0.1137	2.7176	.	.	.	.		
		2014-15	12	14,282	0.2021	3.4475	38,000	1.3869	2.0607	.	.	102	45,029	0.2666	1.3718	-0.0645	2.0758	.	.	.	.		
		2015-16	28	19,395	0.4891	4.5352	38,000	1.4286	3.1067	.	.	102	45,029	0.2666	1.3718	0.2225	3.1635	12,000	5,500	29,000	24,000	0.0083	3.7004
		2016-17	20	5,487	0.4014	1.4765	40,000	1.4414	0.0350	.	.	102	45,029	0.2666	1.3718	0.1348	0.1047	6,500	2,700	32,000	25,000	0.0082	0.6520
WY	Wyoming	2007-2017	110	97,048	0.2348	2.1954	401,000	1.5531	0.6423			960	452,102	0.2731	1.4268	-0.0382	0.7686	18,500	8,200	61,000	49,000	0.0083	1.3658

NASS Honey Report
HoneyColonies = Honey producing colonies
(P) = pooled in "Other State" category

NASS Census
All_Farms = Farms
All_Colonies = Colonies of bees

NASS Honey Bee Colonies

Legend: BIP Surveys = the Bee Informed Partnership Loss Surveys, 2008 to 2017; N = number of valid response sets; Start Colonies = number of honey bee colonies at the start of the Winter season (October 1st); %N = proportion of respondents associated to the specific State in respect to the national total; % Start Col. = proportion of colonies associated to the specific State in respect to the national total. NASS Honey = National Agricultural Statistics Service Honey Report 2008 through 2017; Honey producing col. = number of colonies from which honey was extracted; % H.p.col. = proportion of honey producing colonies associated to the specific State in respect to the national total; Col. allotment residuals = difference between the % Start Col. from BIP survey and the %H.p.col. from NASS Honey Report. NASS Census = National Agricultural Statistics Service Census of Agriculture 2007 and 2012; All Farms = number of farms; All Colonies = number of colonies; NASS Census extrapolated = for years in between 2007 and 2012, the number of farms and colonies were estimated from the mean of the closest published estimates; % Farms = proportion of farms associated to the specific State in respect to the national total; % Colonies = proportion of colonies associated to the specific State in respect to the national total; Farm allotment residuals = difference between the estimate from BIP survey and the estimate from NASS Honey Report; Col. allotment residuals = difference between the estimate from BIP survey and the estimate from NASS Honey Report. NASS Honey Bee Colonies = National Agricultural Statistics Service Honey Bee Colonies Report 2016 and 2017; StartColonies_Apr; StartColonies_Jan; StartColonies_Jul; StartColonies_Oct = number of colonies at the start of each quarter; %Oct.Col = proportion of colonies associated to the specific State in respect to the national total; Oct.Co.Residuals = difference between the estimate from BIP survey and the estimate from NASS Honey Report.

Appendix 2. *Seasonal State Summary by Survey Year*

			All operations in the State									Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2010-11	SUMMER	Alabama	20	19	1	0	310	8.7 [2.4 - 20.3]	25 [11.1 - 38.9]	95.0	96.1	19	298	8.5 [2.1 - 20.7]	25.4 [32.5 - 7.5]	1	(D)	(D)	(D)
2010-11	SUMMER	Alaska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	SUMMER	Arizona	6	5	0	1	1,620	12.7 [11.3 - 14.1]	12.4 [0.2 - 24.6]	83.3	0.9	5	14	13 [3.1 - 31.7]	12.4 [17 - 7.6]	1	(D)	(D)	(D)
2010-11	SUMMER	Arkansas	14	14	0	0	49	18.9 [10.5 - 29.9]	11 [1.3 - 20.6]	85.7	79.6	12	39	24.6 [15.6 - 35.3]	12.8 [19.4 - 5.6]	2	(D)	(D)	(D)
2010-11	SUMMER	California	147	108	9	30	91,064	18.6 [16.5 - 20.9]	13.4 [10.1 - 16.6]	79.6	11.1	117	10,093	18.5 [15.6 - 21.7]	11.5 [20.7 - 1.9]	30	80,971	18.7 [14.2 - 23.8]	20.7 [17.3 - 3.2]
2010-11	SUMMER	Colorado	62	60	2	0	405	8.5 [5.5 - 12.1]	12 [6.9 - 17.1]	98.4	79.8	61	323	7.6 [4.5 - 11.9]	12 [20.7 - 2.6]	1	(D)	(D)	(D)
2010-11	SUMMER	Connecticut	42	40	2	0	389	9.8 [6.5 - 14]	9.3 [4.4 - 14.1]	85.7	38.0	36	148	9.7 [5.2 - 15.8]	9 [16.1 - 2.7]	6	241	9.9 [3.6 - 20.2]	11.1 [16.6 - 6.8]
2010-11	SUMMER	District of Columbia	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	SUMMER	Delaware	7	7	0	0	24	13.9 [5.4 - 27.1]	9 [-1.4 - 19.3]	85.7	79.2	6	19	14.8 [4.6 - 31.8]	8.6 [15.3 - 6.2]	1	(D)	(D)	(D)
2010-11	SUMMER	Florida	58	52	3	3	5,684	21 [19.4 - 22.8]	13.4 [8.1 - 18.7]	91.4	8.9	53	508	10.9 [6.5 - 16.8]	13.1 [21.4 - 2.9]	5	5,176	21.8 [18.4 - 25.5]	16.9 [11.5 - 5.2]
2010-11	SUMMER	Georgia	60	58	1	1	1,213	22.6 [20.5 - 24.8]	13 [8.1 - 18]	96.7	20.8	58	252	25.5 [19.6 - 32.1]	13.1 [19.7 - 2.6]	2	(D)	(D)	(D)
2010-11	SUMMER	Hawaii	33	28	3	2	8,690	26.8 [17.9 - 37.2]	16.9 [8.3 - 25.6]	100.0	100.0	33	8,690	26.8 [17.9 - 37.2]	16.9 [25.3 - 4.4]	0			
2010-11	SUMMER	Idaho	13	11	0	2	8,428	6.3 [4.9 - 7.8]	16 [3.1 - 28.8]	84.6	0.3	11	28	27.5 [15.3 - 42.4]	17.9 [25.4 - 7.6]	2	(D)	(D)	(D)
2010-11	SUMMER	Illinois	55	52	3	0	404	9.6 [6.7 - 13.1]	8 [3.9 - 12]	94.5	79.7	52	322	13.3 [9.5 - 17.7]	8.3 [15.7 - 2.2]	3	(D)	(D)	(D)
2010-11	SUMMER	Indiana	59	57	1	1	3,458	18.9 [17.5 - 20.4]	8.8 [3.9 - 13.7]	98.3	7.5	58	258	7.7 [4.5 - 12.1]	8.6 [19.3 - 2.5]	1	(D)	(D)	(D)
2010-11	SUMMER	Iowa	14	12	2	0	183	37.1 [20.6 - 55.9]	13.8 [2.7 - 24.9]	85.7	68.9	12	126	57.6 [41 - 73.1]	15.7 [22.4 - 6.5]	2	(D)	(D)	(D)
2010-11	SUMMER	Kansas	11	10	1	0	104	11.4 [7.7 - 16]	7.9 [2.2 - 13.6]	81.8	51.9	9	54	8.6 [3.7 - 16.3]	6.6 [10.2 - 3.4]	2	(D)	(D)	(D)
2010-11	SUMMER	Kentucky	21	20	1	0	258	13.9 [7.6 - 22.4]	13.8 [3.5 - 24]	95.2	98.4	20	254	14 [7.6 - 22.8]	14.5 [24.3 - 5.4]	1	(D)	(D)	(D)
2010-11	SUMMER	Louisiana	13	10	2	1	3,962	42.6 [39.3 - 45.9]	19.5 [4.3 - 34.8]	84.6	2.6	11	102	14.5 [5.7 - 28.1]	17.9 [29.7 - 9]	2	(D)	(D)	(D)
2010-11	SUMMER	Maine	42	41	0	1	1,128	21.7 [20.1 - 23.3]	14.9 [8 - 21.7]	92.9	13.8	39	156	15.9 [10.7 - 22.1]	15.1 [23.3 - 3.7]	3	(D)	(D)	(D)
2010-11	SUMMER	Maryland	84	83	1	0	381	25.7 [21.6 - 30]	16.9 [11.9 - 21.8]	98.8	97.6	83	372	25.3 [21.2 - 29.7]	16.5 [23.2 - 2.5]	1	(D)	(D)	(D)
2010-11	SUMMER	Massachusetts	80	80	0	0	306	20.1 [16.2 - 24.5]	14.4 [9.8 - 19]	93.8	84.0	75	257	19.8 [15.7 - 24.5]	14.3 [21.2 - 2.4]	5	49	22.2 [9.2 - 40.5]	16.4 [17.7 - 7.9]
2010-11	SUMMER	Michigan	95	85	7	3	5,896	8.3 [5.8 - 11.4]	15.7 [11.5 - 19.9]	96.8	21.9	92	1,290	14.6 [11.5 - 18.1]	15.7 [21.1 - 2.2]	3	(D)	(D)	(D)
2010-11	SUMMER	Minnesota	27	21	1	5	23,352	35.1 [32.5 - 37.8]	17.7 [10.4 - 25.1]	77.8	1.3	21	309	17.2 [11.6 - 23.8]	13.6 [18.7 - 4.1]	6	23,043	35.6 [30.5 - 40.9]	32.3 [15.1 - 6.2]
2010-11	SUMMER	Mississippi	8	4	0	4	25,520	20.5 [11.3 - 32.4]	20 [7.3 - 32.8]	50.0	0.1	4	(D)	(D)	(D)	4	(D)	(D)	(D)
2010-11	SUMMER	Missouri	71	71	0	0	391	10.3 [7.5 - 13.7]	12.2 [8.1 - 16.3]	97.2	93.6	69	366	10.2 [7.3 - 13.7]	12.3 [17.8 - 2.1]	2	(D)	(D)	(D)
2010-11	SUMMER	Montana	15	10	0	5	14,788	9.6 [8.1 - 11.3]	17.4 [7.8 - 27.1]	66.7	0.6	10	88	20.2 [8.5 - 36.8]	21 [22.6 - 7.2]	5	14,700	9.5 [7.4 - 12.1]	10.4 [4 - 1.8]
2010-11	SUMMER	Nebraska	8	7	0	1	8,064	11.7 [10.7 - 12.9]	13.9 [1.1 - 26.8]	87.5	0.8	7	64	10.4 [3.4 - 22.5]	14.2 [20 - 7.6]	1	(D)	(D)	(D)
2010-11	SUMMER	Nevada	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	SUMMER	New Hampshire	29	28	1	0	312	13.2 [8.9 - 18.4]	14.2 [6.9 - 21.6]	100.0	100.0	29	312	13.2 [8.9 - 18.4]	14.2 [20.2 - 3.8]	0			
2010-11	SUMMER	New Jersey	39	38	1	0	172	11.2 [6.3 - 17.8]	17.2 [8.8 - 25.6]	97.4	99.4	38	171	11.2 [6.2 - 18]	17.3 [27.2 - 4.4]	1	(D)	(D)	(D)
2010-11	SUMMER	New Mexico	10	10	0	0	18	9.7 [0.8 - 33.3]	12.5 [-7.2 - 32.2]	100.0	100.0	10	18	9.7 [0.8 - 33.3]	12.5 [31.7 - 10]	0			
2010-11	SUMMER	New York	78	71	5	2	2,842	17.1 [15.3 - 19]	10.9 [7.4 - 14.4]	87.2	14.6	68	414	13.2 [10.1 - 16.8]	10.3 [15 - 1.8]	10	2,428	17.6 [13.4 - 22.5]	14.9 [19.7 - 6.2]
2010-11	SUMMER	North Carolina	299	293	6	0	2,277	25.7 [22.1 - 29.6]	12.7 [10.3 - 15.1]	95.7	92.0	286	2,094	26.4 [22.6 - 30.5]	12.5 [20.8 - 1.2]	13	183	19.4 [8.1 - 35.7]	17.1 [26.3 - 7.3]
2010-11	SUMMER	North Dakota	15	5	2	8	45,557	18.3 [12.4 - 25.2]	15.9 [6.3 - 25.5]	33.3	0.0	5	8	#VALUE!	0 [0 - 0]	10	45,549	18.3 [11.2 - 27.1]	23.8 [18.7 - 5.9]
2010-11	SUMMER	Ohio	112	112	0	0	431	8.1 [5.9 - 10.6]	7.4 [4.4 - 10.4]	100.0	100.0	112	431	8.1 [5.9 - 10.6]	7.4 [16.3 - 1.5]	0			
2010-11	SUMMER	Oklahoma	15	13	2	0	321	2.7 [0.1 - 11.7]	12.6 [2.6 - 22.6]	80.0	95.3	12	306	2.2 [0 - 12.3]	12.2 [19.6 - 5.7]	3	(D)	(D)	(D)
2010-11	SUMMER	Oregon	74	70	2	2	11,923	9.1 [8.3 - 10]	8.7 [5.2 - 12.2]	91.9	2.3	68	269	14 [10.3 - 18.4]	8.9 [16 - 1.9]	6	11,654	9 [7.3 - 10.9]	6.3 [7.7 - 3.1]
2010-11	SUMMER	Pennsylvania	207	197	9	1	2,786	17.8 [16.4 - 19.3]	9.6 [7.4 - 11.8]	97.1	54.3	201	1,512	13.8 [11.9 - 15.9]	9.6 [16.3 - 1.2]	6	1,274	20.6 [16.4 - 25.2]	9.6 [8.5 - 3.5]
2010-11	SUMMER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	SUMMER	Rhode Island	25	25	0	0	84	8.8 [3.3 - 18]	9 [1.4 - 16.6]	96.0	96.4	24	81	8.3 [2.7 - 18.1]	8.5 [19.6 - 4]	1	(D)	(D)	(D)
2010-11	SUMMER	South Carolina	42	41	1	0	865	14.4 [9.6 - 20.1]	15.8 [8.6 - 23]	88.1	25.5	37	221	18.8 [12.1 - 27.1]	15.6 [24.3 - 4]	5	644	11.9 [3.4 - 27]	17.2 [23.7 - 10.6]
2010-11	SUMMER	South Dakota	6	5	0	1	933	25.2 [22.5 - 27.9]	4.3 [-4.1 - 12.6]	83.3	3.5	5	33	#VALUE!	0 [0 - 0]	1	(D)	(D)	(D)
2010-11	SUMMER	Tennessee	45	44	1	0	270	14.4 [8.9 - 21.3]	12.7 [6.3 - 19.2]	91.1	80.4	41	217	11.8 [7.3 - 17.7]	12.5 [21.6 - 3.4]	4	(D)	(D)	(D)
2010-11	SUMMER	Texas	37	28	1	8	36,219	20.4 [16.7 - 24.5]	10.2 [4.7 - 15.7]	75.7	2.1	28	772	6.8 [3.7 - 11.1]	5.7 [14.8 - 2.8]	9	35,447	20.8 [13.5 - 29.6]	24 [16.8 - 5.6]
2010-11	SUMMER	Utah	46	45	0	1	1,778	12.7 [11 - 14.4]	8.1 [3.2 - 13]	95.7	8.7	44	154	10 [6.4 - 14.6]	7.1 [16.2 - 2.4]	2	(D)	(D)	(D)
2010-11	SUMMER	Vermont	35	34	0	1	790	9.3 [7.6 - 11.2]	5.8 [2.3 - 9.4]	88.6	18.9	31	149	4.2 [1.8 - 8.1]	4.7 [10.8 - 1.9]	4	(D)	(D)	(D)
2010-11	SUMMER	Virginia	176	174	2	0	817	12.3 [9.7 - 15.2]	10.7 [7.8 - 13.6]	97.7	94.6	172	773	13.1 [10.4 - 16]	10.7 [19.5 - 1.5]	4	(D)	(D)	(D)
2010-11	SUMMER	Washington	69	61	3	5	14,665	9.4 [8.4 - 10.4]	9.9 [6.3 - 13.6]	89.9	2.3	62	341	11.8 [8.8 - 15.3]	9.8 [16.1 - 2]	7	14,324	9.3 [6.7 - 12.4]	10.7 [8.6 - 3.3]
2010-11	SUMMER	West Virginia	25	24	1	0	193	37.1 [26.8 - 48.3]	6.1 [-0.2 - 12.3]	92.0	48.7	23	94	5.9 [1.8 - 13.5]	4.1 [12.2 - 2.5]	2	(D)	(D)	(D)
2010-11	SUMMER	Wisconsin	50	48	1	1	3,773	19.3 [18 - 20.7]	14.3 [8.9 - 19.7]	92.0	14.0	46	529	16.2 [13.1 - 19.7]	14.6 [20.1 - 3]	4	(D)	(D)	(D)
2010-11	SUMMER	Wyoming	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	SUMMER	Other	0																
2010-11	SUMMER	MultiStateOperation	77	37	15	25	83,904	18.5 [15.7 - 21.6]	15.9 [12 - 19.9]	0.0	0.0	77	83,904	18.5 [15.7 - 21.6]	15.9 [17.8 - 2]	77	83,904	18.5 [15.7 - 21.6]	15.9 [17.8 - 2]
2011-12	SUMMER	Alabama	27	26	1	0	399	24.8 [19.1 - 31]	9.5 [3.7 - 15.2]	96.3	99.7	26	398	24.5 [18.8 - 30.9]	8.4 [14.5 - 2.9]	1	(D)	(D)	(D)
2011-12	SUMMER	Alaska	0																
2011-12	SUMMER	Arizona	7	5	2	0	275	6.7 [2.7 - 13.2]	1.9 [-1.8 - 5.5]	71.4	47.3	5	130	#VALUE!	0 [0 - 0]	2	(D)	(D)	(D)
2011-12	SUMMER	Arkansas	25	23	2	0	273	19.8 [14.7 - 25.6]	13.4 [6.8 - 20.1]	96.0	76.2	24	208	14.6 [10.2 - 19.9]	12.5 [16.7 - 3.4]	1	(D)	(D)	(D)
2011-12	SUMMER	California	189	141	18	30	118,537	17.6 [15.3 - 20.1]	12.1 [9.6 - 14.6]	82.0	28.1	155	33,266	12.7 [10.7 - 14.8]	11.5 [18.3 - 1.5]	34	85,271	19.6 [14.1 - 26.1]	15 [13.3 - 2.3]
2011-12	SUMMER	Colorado	70	67	3	0	545	14.9 [11.2 - 19.2]	13.5 [8.4 - 18.5]	98.6	77.1	69	420	18.2 [14.4 - 22.5]	13.7 [21.6 - 2.6]	1	(D)	(D)	(D)
2011-12	SUMMER	Connecticut	31	30	1	0	224	4.1 [1.4 - 8.7]	6 [1.2 - 10.9]	87.1	45.5	27	102	7 [3.1 - 13]	6.7 [14.6 - 2.8]	4	(D)	(D)	(D)
2011-12	SUMMER	District of Columbia	5	4	0	1	1,266	53.3 [47.1 - 59.4]	10.8 [-10.4 - 32]	100.0	100.0	5	1,266	53.3 [47.1 - 59.4]	10.8 [24.2 - 10.8]	0			
2011-12	SUMMER	Delaware	20	18	2	0	138	9.2 [5.8 - 13.5]	10.9 [4.1 - 17.7]	90.0	79.7	18	110	9.8 [5 - 16.7]	11.6 [16.2 - 3.8]	2	(D)	(D)	(D)
2011-12	SUMMER	Florida	82	69	4	9	28,148	36.2 [32.5 - 40]	15.3 [10.8 - 19.7]	87.8	12.4	72	3,477	17.5 [12.9 - 22.7]	14.3 [20.8 - 2.5]	10	24,671	38.5 [29.1 - 48.5]	21.9 [18.6 - 5.9]
2011-12	SUMMER	Georgia	99	94	2	3	7,618	35.1 [31.8 - 38.5]	12.9 [8.8 - 17]	91.9	9.9	91	751	12.1 [8.8 - 15.9]	12.6 [21 - 2.2]	8	6,867	37 [26.2 - 48.7]	15.8 [19 - 6.7]
2011-12	SUMMER	Hawaii	20	15	2	3	11,097	18.2 [8.6 - 31.6]	17.1 [5.5 - 28.7]	100.0	100.0	20	11,097	18.2 [8.6 - 31.6]	17.1 [26.4 - 5.9]	0			
2011-12	SUMMER	Idaho	22	19	0	3	5,416	17.8 [14.1 - 21.9]	12.5 [3.6 - 21.4]	81.8	1.3	18	73	10.5 [4.5 - 19.6]	9.6 [19.9 - 4.7]	4	(D)	(D)	(D)
2011-12	SUMMER	Illinois	54	52	2	0	407	16.3 [12.1 - 21.2]	11.2 [5.9 - 16.6]	98.1	78.6	53	320	19.4 [14.2 - 25.5]	11.2 [20.2 - 2.8]	1	(D)	(D)	(D)
2011-12	SUMMER	Indiana	62	59	2	1	1,421	10.9 [9 - 12.9]	7.9 [4 - 11.9]	95.2	28.5	59	405	6.4 [3.6 - 10.2]	7.8 [16.3 - 2.1]	3	(D)	(D)	(D)
2011-12	SUMMER	Iowa	24	22	2	0	258	10.9 [7.9 - 14.6]	8.9 [3.6 - 14.2]	95.8	66.3	23	171	10.5 [6.1 - 16.3]	8.8 [13.6 - 2.8]	1	(D)	(D)	(D)
2011-12	SUMMER	Kansas	15	12	3	0	454	17.8 [12.8 - 23.6]	7.7 [0.4 - 15]	86.7	33.9	13	154	7.5 [3.6 - 13.3]	5.5 [14.1 - 3.9]	2	(D)	(D)	(D)
2011-12	SUMMER	Kentucky	30	28	2	0	371	9 [5.1 - 14.3]	9.7 [4.5 - 14.8]	96.7	97.3	29	361	8.2 [4.2 - 13.9]	9.4 [14.6 - 2.7]	1	(D)	(D)	(D)
2011-12	SUMMER	Louisiana	14	12	2	0	891	54.3 [42.4 - 65.8]	22.5 [8.8 - 36.1]	100.0	100.0	14	891	54.3 [42.4 - 65.8]	22.5 [26.1 - 7]	0			
2011-12	SUMMER	Maine	77	70	4	3	18,177	45.5 [43.8 - 47.3]	11.1 [7.2 - 14.9]	92.2	2.5	71	459	12.5 [9.5 - 15.9]	9.7 [16.3 - 1.9]	6	17,718	46.6 [42.6 - 50.5]	27.1 [21 - 8.6]
2011-12	SUMMER	Maryland	205	202	3	0	1,069	17.5 [14.7 - 20.6]	12.1 [9.4 - 14.9]	98.5	96.5	202	1,032	19 [16 - 22.3]	12.2 [20.1 - 1.4]	3	(D)	(D)	(D)
2011-12	SUMMER	Massachusetts	129	125	3	1	13,079	45.6 [44.2 - 47.1]	10 [6.9 - 13.1]	95.3	3.4	123	451	10.5 [7.9 - 13.5]	9.7 [18 - 1.6]	6	12,628	47.1 [44.4 - 49.7]	15.2 [19.2 - 7.8]
2011-12	SUMMER	Michigan	120	110	7	3	6,028	13.3 [11.5 - 15.1]	8.5 [5.5 - 11.5]	96.7	16.6	116	1,003	9.9 [7.8 - 12.3]	8.4 [16.9 - 1.6]	4	(D)	(D)	(D)
2011-12	SUMMER	Minnesota	33	32	1	0	387	13.4 [9.4 - 18.3]	14.6 [7.7 - 21.5]	97.0	96.9	32	375	13.3 [9.2 - 18.4]	14.5 [20.5 - 3.6]	1	(D)	(D)	(D)
2011-12	SUMMER	Mississippi	5	5	0	0	33	8.9 [2.1 - 22.4]	4.2 [-4 - 12.5]	100.0	100.0	5	33	8.9 [2.1 - 22.4]	4.2 [9.4 - 4.2]	0			
2011-12	SUMMER	Missouri	57	53	4	0	520	13.6 [10.6 - 16.9]	7.5 [4.4 - 10.6]	96.5	60.8	55	316	7.6 [5.3 - 10.5]	7 [11.9 - 1.6]	2	(D)	(D)	(D)
2011-12	SUMMER	Montana	16	9	1	6	21,511	10.6 [8.5 - 13]	9.6 [3.2 - 16.1]	62.5	5.1	10	1,091	#VALUE!	7.4 [15.8 - 5]	6	20,420	11.1 [8 - 14.8]	13.3 [6.5 - 2.7]
2011-12	SUMMER	Nebraska	6	5	0	1	9,514	5.3 [4.5 - 6.1]	10.6 [-1.2 - 22.4]	83.3	0.1	5	14	12.9 [3.1 - 31]	11.7 [16.2 - 7.3]	1	(D)	(D)	(D)
2011-12	SUMMER	Nevada	11	8	2	1	1,602	7.1 [5.2 - 9.3]	6.9 [-1.9 - 15.7]	72.7	3.2	8	52	9.1 [3 - 19.5]	8.5 [17.3 - 6.1]	3	(D)	(D)	(D)
2011-12	SUMMER	New Hampshire	34	32	2	0	363	16.2 [11.8 - 21.3]	16 [8.8 - 23.2]	88.2	82.4	30	299	18.6 [14 - 23.9]	15.8 [21.5 - 3.9]	4	(D)	(D)	(D)
2011-12	SUMMER	New Jersey	47	44	3	0	412	15.3 [12.1 - 19]	10.5 [6.2 - 14.7]	85.1	82.5	40	340	16.6 [12.9 - 20.8]	10.9 [15.8 - 2.5]	7	72	10.6 [6.1 - 16.7]	8 [7.6 - 2.9]
2011-12	SUMMER	New Mexico	10	9	1	0	168	4.8 [2 - 9.1]	4.6 [-1.9 - 11.1]	100.0	100.0	10	168	4.8 [2 - 9.1]	4.6 [10.5 - 3.3]	0			
2011-12	SUMMER	New York	125	111	11	3	8,073	34.6 [31.5 - 37.8]	11.1 [8.1 - 14.1]	91.2	13.4	114	1,079	13 [10.6 - 15.7]	10.6 [17.1 - 1.6]	11	6,994	38.6 [29.3 - 48.6]	16 [17 - 5.1]
2011-12	SUMMER	North Carolina	274	272	2	0	1,553	15.3 [13.2 - 17.6]	12.1 [9.8 - 14.4]	97.8	96.1	268	1,492	15.6 [13.4 - 18]	12.2 [19.8 - 1.2]	6	61	10.8 [7.4 - 15.1]	6.5 [7.2 - 2.9]
2011-12	SUMMER	North Dakota	11	1	2	8	34,561	6.4 [2.5 - 12.5]	12.4 [6.3 - 18.5]	18.2	5.5	2	(D)	(D)	(D)	9	32,654	5.9 [1.9 - 13.3]	13.8 [10.6 - 3.5]
2011-12	SUMMER	Ohio	149	141	6	2	2,533	11.6 [10.1 - 13.1]	6.8 [4.4 - 9.2]	97.3	57.8	145	1,465	10.7 [8.9 - 12.7]	6.6 [14.7 - 1.2]	4	(D)	(D)	(D)
2011-12	SUMMER	Oklahoma	19	19	0	0	106	20.4 [11.4 - 31.9]	20.1 [9.5 - 30.7]	100.0	100.0	19	106	20.4 [11.4 - 31.9]	20.1 [23.6 - 5.4]	0			
2011-12	SUMMER	Oregon	80	72	3	5	21,472	9.7 [8.9 - 10.6]	8.5 [5.2 - 11.8]	90.0	14.8	72	3,186	8.9 [8.2 - 9.8]	7.9 [13.5 - 1.6]	8	18,286	9.9 [7.2 - 13]	16.1 [19.7 - 7]
2011-12	SUMMER	Pennsylvania	400	380	18	2	8,364	34 [32.2 - 35.9]	8.4 [6.7 - 10]	95.8	29.9	383	2,498	13.7 [11.9 - 15.6]	8.1 [16.6 - 0.8]	17	5,866	41.7 [35.6 - 47.9]	13.6 [15.6 - 3.8]
2011-12	SUMMER	Puerto Rico	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	SUMMER	Rhode Island	18	18	0	0	56	7.1 [2.5 - 14.8]	7.3 [0.7 - 13.9]	100.0	100.0	18	56	7.1 [2.5 - 14.8]	7.3 [14.3 - 3.4]	0			
2011-12	SUMMER	South Carolina	63	60	3	0	1,177	16.9 [13.9 - 20.3]	16.7 [11.3 - 22.2]	95.2	39.7	60	467	16.4 [12.4 - 21]	16.9 [22.5 - 2.9]	3	(D)	(D)	(D)
2011-12	SUMMER	South Dakota	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	SUMMER	Tennessee	74	69	5	0	583	14.9 [11.7 - 18.4]	9.3 [5.7 - 12.8]	93.2	83.2	69	485	13 [9.7 - 16.8]	8.6 [15.5 - 1.9]	5	98	21 [10.9 - 34.4]	19.2 [15.8 - 7.1]
2011-12	SUMMER	Texas	27	24	1	2	13,198	17 [10.5 - 25.3]	12.7 [5.2 - 20.2]	92.6	27.9	25	3,688	46.9 [43.1 - 50.7]	12.9 [20.6 - 4.1]	2	(D)	(D)	(D)
2011-12	SUMMER	Utah	49	47	1	1	2,783	20.7 [19.4 - 21.9]	11 [6.2 - 15.9]	98.0	6.6	48	183	11.4 [7.7 - 15.9]	10.8 [17.4 - 2.5]	1	(D)	(D)	(D)
2011-12	SUMMER	Vermont	51	48	2	1	1,134	3.5 [2 - 5.8]	7.3 [3.3 - 11.4]	92.2	21.6	47	245	7.8 [5 - 11.4]	6.8 [13.9 - 2]	4	(D)	(D)	(D)
2011-12	SUMMER	Virginia	322	317	5	0	1,695	13.8 [11.9 - 15.9]	9.7 [7.8 - 11.6]	98.1	97.3	316	1,649	14 [12 - 16.1]	9.8 [17.4 - 1]	6	46	5.1 [1.6 - 11.5]	3.3 [5.8 - 2.4]
2011-12	SUMMER	Washington	74	64	6	4	33,460	6.3 [4.8 - 8.2]	12.5 [8.5 - 16.4]	91.9	2.8	68	933	11.5 [8.7 - 14.7]	12.3 [17.7 - 2.1]	6	32,527	6.1 [1.8 - 14]	14.5 [11.1 - 4.5]
2011-12	SUMMER	West Virginia	34	32	2	0	236	9.3 [6.8 - 12.2]	6.3 [2.6 - 10.1]	88.2	52.1	30	123	4.7 [1.9 - 9.3]	5.6 [11.3 - 2.1]	4	(D)	(D)	(D)
2011-12	SUMMER	Wisconsin	78	77	1	0	459	17.6 [14 - 21.5]	15.6 [11.5 - 19.7]	96.2	96.3	75	442	17.7 [14.1 - 21.8]	15.9 [18.8 - 2.2]	3	(D)	(D)	(D)
2011-12	SUMMER	Wyoming	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	SUMMER	Other	0																
2011-12	SUMMER	MultiStateOperation	91	40	24	27	94,892	18.9 [15.6 - 22.6]	12.8 [10.1 - 15.6]	0.0	0.0	91	94,892	18.9 [15.6 - 22.6]	12.8 [13.4 - 1.4]	91	94,892	18.9 [15.6 - 22.6]	12.8 [13.4 - 1.4]
2012-13	SUMMER	Alabama	36	35	1	0	422	16.9 [12.3 - 22.3]	12.7 [7 - 18.3]	94.4	63.7	34	269	15.7 [10.3 - 22.5]	12.8 [17.6 - 3]	2	(D)	(D)	(D)

SurveyYear	Season	State	All operations in the State N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2012-13	SUMMER	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	SUMMER	Arizona	9	8	0	1	1,770	10.1 [8.8 - 11.5]	11.1 [1.2 - 21]	88.9	1.1	8	20	11.4 [3.3 - 26]	11.3 [16.2 - 5.7]	1	(D)	(D)	(D)
2012-13	SUMMER	Arkansas	37	34	1	2	1,312	17.4 [14.5 - 20.5]	14.9 [7.4 - 22.4]	97.3	96.2	36	1,262	17.9 [15.2 - 20.9]	15.3 [23.5 - 3.9]	1	(D)	(D)	(D)
2012-13	SUMMER	California	215	112	28	75	404,978	27.1 [25.2 - 29.1]	17.1 [14.8 - 19.4]	63.7	11.3	137	45,718	20.4 [17.7 - 23.4]	13.8 [17.9 - 1.5]	78	359,260	28 [25 - 31.2]	23 [15.2 - 1.7]
2012-13	SUMMER	Colorado	167	164	3	0	819	12.2 [9.8 - 15]	10.5 [7.6 - 13.4]	97.6	82.5	163	676	11.4 [8.8 - 14.3]	10.4 [19.3 - 1.5]	4	(D)	(D)	(D)
2012-13	SUMMER	Connecticut	57	54	3	0	517	13.1 [9.3 - 17.6]	17.1 [11.5 - 22.8]	91.2	68.3	52	353	11.7 [7.5 - 17.1]	17.5 [22.4 - 3.1]	5	164	16.1 [7.7 - 28]	13.1 [13.6 - 6.1]
2012-13	SUMMER	District of Columbia	10	8	2	0	242	42.9 [30.7 - 55.7]	14.8 [1.1 - 28.5]	70.0	8.7	7	21	8.7 [0.7 - 30.9]	7.1 [18.9 - 7.1]	3	(D)	(D)	(D)
2012-13	SUMMER	Delaware	23	19	2	2	11,817	48.4 [43.3 - 53.6]	13.5 [5.9 - 21.1]	82.6	1.0	19	117	9.4 [4.5 - 16.5]	12.7 [17.8 - 4.1]	4	(D)	(D)	(D)
2012-13	SUMMER	Florida	103	76	12	15	46,986	29.5 [25.9 - 33.2]	18.2 [14.3 - 22.1]	79.6	13.9	82	6,519	22 [18.4 - 25.9]	16.3 [19.9 - 2.2]	21	40,467	30.5 [22.7 - 39.1]	25.7 [20.5 - 4.5]
2012-13	SUMMER	Georgia	74	64	7	3	6,874	14.3 [12 - 16.8]	12.4 [8.3 - 16.5]	85.1	8.5	63	587	13.1 [9.9 - 16.9]	11.7 [18.5 - 2.3]	11	6,287	14.4 [8.9 - 21.4]	16.5 [13.1 - 4]
2012-13	SUMMER	Hawaii	45	36	6	3	10,107	15.1 [8.8 - 23.2]	18.8 [10.9 - 26.6]	97.8	95.1	44	9,607	15.6 [9.1 - 24]	19.1 [27 - 4.1]	1	(D)	(D)	(D)
2012-13	SUMMER	Idaho	31	16	3	12	64,792	24.1 [20.2 - 28.2]	20.1 [13 - 27.3]	48.4	1.6	15	1,042	7.1 [3.2 - 13]	13.2 [21.1 - 5.5]	16	63,750	24.3 [19.1 - 30.1]	26.6 [17.8 - 4.5]
2012-13	SUMMER	Illinois	132	130	1	1	3,694	4 [2.1 - 6.8]	9.6 [6.6 - 12.7]	97.0	18.6	128	686	16.2 [12.4 - 20.6]	9.8 [18.1 - 1.6]	4	(D)	(D)	(D)
2012-13	SUMMER	Indiana	108	104	3	1	2,625	6 [4.6 - 7.7]	9.7 [6.8 - 12.7]	96.3	26.8	104	704	8.9 [6.5 - 11.6]	9.8 [15.8 - 1.5]	4	(D)	(D)	(D)
2012-13	SUMMER	Iowa	45	35	8	2	4,701	10.3 [6.2 - 15.7]	12.2 [7.2 - 17.1]	91.1	33.8	41	1,588	23.2 [18 - 29]	12.2 [17.4 - 2.7]	4	(D)	(D)	(D)
2012-13	SUMMER	Kansas	39	33	5	1	1,382	20 [14.9 - 25.8]	13 [7.5 - 18.5]	87.2	22.7	34	314	16.7 [11 - 23.7]	13.5 [18 - 3.1]	5	1,068	20.8 [8 - 39.6]	9.6 [15 - 6.7]
2012-13	SUMMER	Kentucky	46	43	3	0	421	18.4 [12.8 - 25]	10.3 [5.2 - 15.3]	93.5	91.2	43	384	19.3 [13.3 - 26.4]	10.3 [18.1 - 2.8]	3	(D)	(D)	(D)
2012-13	SUMMER	Louisiana	14	13	1	0	490	38.8 [31.4 - 46.6]	13.3 [3.9 - 22.7]	100.0	100.0	14	490	38.8 [31.4 - 46.6]	13.3 [18 - 4.8]	0			
2012-13	SUMMER	Maine	103	96	2	5	45,213	29 [26.1 - 32]	12.1 [8.5 - 15.7]	94.2	1.3	97	601	9.7 [7.4 - 12.4]	10.8 [18.1 - 1.8]	6	44,612	29.3 [17.5 - 43.3]	32.1 [17.5 - 7.1]
2012-13	SUMMER	Maryland	181	173	6	2	12,839	47.6 [45.5 - 49.7]	13.8 [10.8 - 16.8]	95.0	7.0	172	905	30.8 [26.7 - 35]	13.5 [20.7 - 1.6]	9	11,934	48.8 [40.7 - 56.9]	19.1 [21.4 - 7.1]
2012-13	SUMMER	Massachusetts	151	149	1	1	14,518	19.7 [19.2 - 20.3]	13.3 [10.2 - 16.4]	97.4	3.5	147	507	14.2 [11.5 - 17.1]	13.4 [19.6 - 1.6]	4	(D)	(D)	(D)
2012-13	SUMMER	Michigan	205	189	11	5	22,462	31.7 [28.6 - 35]	13.6 [10.9 - 16.3]	96.6	9.8	198	2,200	16.4 [13.6 - 19.5]	13.5 [19.7 - 1.4]	7	20,262	33.6 [17.3 - 53.1]	16.2 [20.4 - 7.7]
2012-13	SUMMER	Minnesota	74	61	2	11	45,182	30.4 [26.4 - 34.6]	16.9 [12.1 - 21.7]	83.8	21.3	62	9,645	13.9 [12.8 - 15]	13.7 [19.7 - 2.5]	12	35,537	36.1 [26.5 - 46.6]	33.4 [20.7 - 6]
2012-13	SUMMER	Mississippi	27	19	4	4	108,564	38.8 [36.3 - 41.4]	15.9 [9 - 22.9]	81.5	0.7	22	782	19.4 [13.7 - 26.2]	12.9 [17.3 - 3.7]	5	107,782	39 [33 - 45.2]	29.3 [18.7 - 8.4]
2012-13	SUMMER	Missouri	76	71	5	0	937	11.2 [8.2 - 14.7]	13 [8.9 - 17.2]	97.4	73.4	74	688	15 [11.6 - 18.9]	13.3 [18.7 - 2.2]	2	(D)	(D)	(D)
2012-13	SUMMER	Montana	27	17	1	9	30,237	14 [9.8 - 19]	18.9 [11.2 - 26.5]	59.3	0.2	16	69	16.7 [7.6 - 29.6]	18 [22.3 - 5.6]	11	30,168	14 [7.7 - 22.4]	20.1 [18.2 - 5.5]
2012-13	SUMMER	Nebraska	14	10	1	3	85,765	39.2 [35 - 43.5]	16.7 [2.2 - 31.3]	71.4	0.2	10	206	3.7 [0.5 - 11.9]	15.2 [30.9 - 9.8]	4	(D)	(D)	(D)
2012-13	SUMMER	Nevada	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	SUMMER	New Hampshire	57	55	2	0	511	7.5 [4.9 - 10.8]	10.3 [5.8 - 14.9]	100.0	100.0	57	511	7.5 [4.9 - 10.8]	10.3 [17.6 - 2.3]	0			
2012-13	SUMMER	New Jersey	61	59	0	2	24,259	34.9 [30.8 - 39.2]	15.8 [10.9 - 20.8]	90.2	0.9	55	210	19 [14.1 - 24.6]	14.4 [19.5 - 2.6]	6	24,049	35.1 [21.9 - 50.1]	28.3 [19 - 7.8]
2012-13	SUMMER	New Mexico	9	9	0	0	42	6.4 [1.2 - 17.9]	11.5 [0.7 - 22.3]	88.9	90.5	8	38	6.9 [1.2 - 19.6]	12.9 [17 - 6]	1	(D)	(D)	(D)
2012-13	SUMMER	New York	178	156	11	11	39,988	31.2 [28.7 - 33.7]	11.3 [8.8 - 13.8]	90.4	7.0	161	2,783	18.8 [16.7 - 21.1]	10.2 [16.8 - 1.3]	17	37,205	32.2 [24.3 - 40.7]	22 [15.6 - 3.8]
2012-13	SUMMER	North Carolina	277	271	5	1	3,578	26.3 [23.4 - 29.2]	13.8 [11.3 - 16.2]	96.8	67.1	268	2,402	12.2 [10.3 - 14.3]	13.6 [20.5 - 1.3]	9	1,176	52.5 [44.2 - 60.6]	18.2 [21.9 - 7.3]
2012-13	SUMMER	North Dakota	36	5	1	30	189,516	23.7 [19.8 - 28]	24 [18.8 - 29.3]	8.3	0.0	3	(D)	(D)	(D)	33	189,504	23.7 [19.6 - 28.2]	25.7 [15.5 - 2.7]
2012-13	SUMMER	Ohio	182	178	3	1	11,444	48.9 [46.9 - 51]	11.2 [8.6 - 13.7]	98.9	12.5	180	1,434	19.1 [15.5 - 23.1]	10.9 [17.6 - 1.3]	2	(D)	(D)	(D)
2012-13	SUMMER	Oklahoma	29	26	2	1	3,632	59.8 [55.2 - 64.3]	20.2 [11.5 - 28.9]	93.1	8.8	27	320	27.7 [19.9 - 36.6]	19.2 [23.2 - 4.5]	2	(D)	(D)	(D)
2012-13	SUMMER	Oregon	122	108	9	5	22,053	18.6 [17 - 20.2]	8.7 [5.9 - 11.5]	91.0	29.1	111	6,414	20.3 [18.9 - 21.6]	8.7 [16.3 - 1.5]	11	15,639	17.6 [12.2 - 24]	9.4 [10.1 - 3.1]
2012-13	SUMMER	Pennsylvania	350	327	18	5	22,096	34.2 [32.1 - 36.3]	9.9 [8.2 - 11.5]	95.7	12.0	335	2,646	13 [11.5 - 14.5]	9.5 [16 - 0.9]	15	19,450	37.2 [27.8 - 47.3]	16.7 [17.3 - 4.5]
2012-13	SUMMER	Puerto Rico	0																
2012-13	SUMMER	Rhode Island	15	15	0	0	62	5.1 [0.5 - 17.7]	8.9 [-1.5 - 19.4]	73.3	79.0	11	49	8.2 [1.1 - 25.4]	12.2 [23.5 - 7.1]	4	(D)	(D)	(D)
2012-13	SUMMER	South Carolina	68	65	1	2	4,069	13.6 [12 - 15.3]	11.5 [7.6 - 15.4]	95.6	9.3	65	379	11.6 [8.5 - 15.2]	11.3 [16.5 - 2]	3	(D)	(D)	(D)
2012-13	SUMMER	South Dakota	6	2	0	4	85,132	40 [35.4 - 44.7]	17.5 [4.6 - 30.4]	33.3	0.0	2	(D)	(D)	(D)	4	(D)	(D)	(D)
2012-13	SUMMER	Tennessee	56	51	5	0	626	16 [13.1 - 19.3]	8.1 [4.4 - 11.7]	91.1	57.3	51	359	13.3 [9.6 - 17.6]	7.5 [14.3 - 2]	5	267	19.6 [14.9 - 24.9]	13.6 [9.9 - 4.4]
2012-13	SUMMER	Texas	56	41	2	13	66,951	24.6 [22.4 - 26.8]	12.9 [8.5 - 17.3]	73.2	0.6	41	411	7.2 [3.4 - 12.8]	9.3 [16.1 - 2.5]	15	66,540	24.7 [20.6 - 29.1]	22.7 [14.7 - 3.8]
2012-13	SUMMER	Utah	46	37	5	4	9,736	17.5 [15.5 - 19.6]	16.1 [10.2 - 21.9]	84.8	3.0	39	291	26.7 [19.9 - 34.3]	16.2 [21.7 - 3.5]	7	9,445	17.2 [13.1 - 21.9]	15.2 [9.7 - 3.7]
2012-13	SUMMER	Vermont	39	34	2	3	2,854	8.5 [6.4 - 11.1]	10.7 [4.7 - 16.8]	89.7	45.0	35	1,285	6.9 [4.3 - 10.2]	11.5 [20.1 - 3.4]	4	(D)	(D)	(D)
2012-13	SUMMER	Virginia	470	458	10	2	14,497	42.9 [41.3 - 44.6]	12.8 [11 - 14.6]	97.4	18.5	458	2,677	15.8 [14.1 - 17.5]	12.6 [19.6 - 0.9]	12	11,820	48.8 [41.9 - 55.8]	19.9 [23.4 - 6.8]
2012-13	SUMMER	Washington	110	97	5	8	49,972	28.5 [26.8 - 30.2]	14.1 [10.2 - 18.1]	89.1	1.3	98	665	14.4 [11 - 18.3]	13.2 [21.7 - 2.2]	12	49,307	28.8 [23.9 - 34]	21.8 [14.2 - 4.1]
2012-13	SUMMER	West Virginia	60	58	1	1	2,124	14.1 [12.6 - 15.8]	8.6 [5.3 - 12]	93.3	19.1	56	406	7.4 [4.9 - 10.6]	8.8 [13.6 - 1.8]	4	(D)	(D)	(D)
2012-13	SUMMER	Wisconsin	129	112	12	5	19,100	35.4 [31.5 - 39.4]	16.8 [12.9 - 20.7]	93.0	13.6	120	2,591	17.5 [15.1 - 20]	16.4 [22.4 - 2]	9	16,509	38.4 [23.8 - 54.5]	22.9 [23.9 - 8]
2012-13	SUMMER	Wyoming	13	7	2	4	13,370	15.6 [11.2 - 20.8]	10.9 [3.5 - 18.3]	53.8	0.7	7	98	3.6 [0.1 - 19.4]	8.3 [16 - 6]	6	13,272	15.7 [9.3 - 24]	13.9 [11 - 4.5]
2012-13	SUMMER	Other	0																
2012-13	SUMMER	MultiStateOperation	163	49	37	77	397,024	27.5 [25.3 - 29.7]	18.9 [16.3 - 21.5]	0.0	0.0	163	397,024	27.5 [25.3 - 29.7]	18.9 [17.1 - 1.3]	163	397,024	27.5 [25.3 - 29.7]	18.9 [17.1 - 1.3]
2013-14	SUMMER	Alabama	35	34	1	0	599	54 [43.1 - 64.7]	13.6 [7 - 20.2]	94.3	41.4	33	248	21.3 [15.7 - 27.8]	11.9 [16.5 - 2.9]	2	(D)	(D)	(D)
2013-14	SUMMER	Alaska	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2013-14	SUMMER	Arizona	6	5	1	0	204	21.4 [17.2 - 25.9]	23.6 [-7.4 - 54.7]	83.3	97.1	5	198	21.6 [17.6 - 26.1]	28.4 [41.4 - 18.5]	1	(D)	(D)	(D)
2013-14	SUMMER	Arkansas	61	56	3	2	6,713	17 [15.5 - 18.5]	19.9 [12.7 - 27.2]	91.8	6.5	56	438	20.1 [15.5 - 25.2]	20.8 [30 - 4]	5	6,275	16.7 [13.5 - 20.2]	10.8 [9.2 - 4.1]
2013-14	SUMMER	California	269	170	27	72	294,045	17.8 [16.2 - 19.5]	20.4 [17.5 - 23.4]	67.3	5.4	181	15,874	22.4 [18.8 - 26.3]	21.7 [27.9 - 2.1]	88	278,171	17.5 [14.9 - 20.3]	17.9 [16 - 1.7]
2013-14	SUMMER	Colorado	179	177	1	1	42,715	11.3 [10.9 - 11.7]	15 [11.6 - 18.4]	97.8	1.5	175	620	18.6 [15.2 - 22.4]	15.3 [23.5 - 1.8]	4	(D)	(D)	(D)
2013-14	SUMMER	Connecticut	66	64	2	0	1,295	70.3 [59.2 - 80]	14.1 [8.3 - 20]	90.9	18.3	60	237	10.2 [6.3 - 15.4]	12.4 [22.3 - 2.9]	6	1,058	89.7 [51 - 99.9]	31.3 [36.7 - 15]
2013-14	SUMMER	District of Columbia	6	5	1	0	110	50 [41.3 - 58.7]	11.8 [-5.2 - 28.7]	66.7	14.5	4	(D)	(D)	(D)	2	(D)	(D)	(D)
2013-14	SUMMER	Delaware	22	21	0	1	12,097	33.2 [31.9 - 34.4]	20.6 [8.7 - 32.5]	77.3	0.5	17	63	23.8 [12.3 - 38.6]	22.7 [30.9 - 7.5]	5	12,034	33.2 [31.3 - 35.2]	13.3 [18.3 - 8.2]
2013-14	SUMMER	Florida	170	140	9	21	52,965	23.9 [21.4 - 26.4]	19.8 [16 - 23.7]	82.4	6.7	140	3,557	21.3 [18.5 - 24.2]	19.5 [26.8 - 2.3]	30	49,408	24.1 [18.4 - 30.4]	21.5 [19.1 - 3.5]
2013-14	SUMMER	Georgia	102	89	5	8	14,949	27.3 [24.2 - 30.6]	19.1 [13.5 - 24.6]	86.3	8.2	88	1,222	12.6 [9.6 - 16.2]	17.7 [28.8 - 3.1]	14	13,727	28.3 [20.3 - 37.5]	27.7 [25.6 - 6.9]
2013-14	SUMMER	Hawaii	67	60	4	3	11,804	14.5 [12.8 - 16.4]	14.7 [10 - 19.3]	98.5	53.4	66	6,304	10.8 [8.6 - 13.3]	14.6 [19.6 - 2.4]	1	(D)	(D)	(D)
2013-14	SUMMER	Idaho	34	16	2	16	81,574	16.5 [12.9 - 20.6]	15.6 [9.7 - 21.6]	55.9	7.4	19	6,050	3.9 [2.2 - 6.3]	16.5 [21.2 - 4.9]	15	75,524	17.5 [12.2 - 23.9]	14.5 [12.7 - 3.3]
2013-14	SUMMER	Illinois	127	125	1	1	973	8.4 [6.3 - 10.9]	13.6 [9.8 - 17.3]	96.9	68.0	123	662	14.3 [11.2 - 17.8]	13.9 [22 - 2]	4	(D)	(D)	(D)
2013-14	SUMMER	Indiana	179	173	5	1	2,919	15.1 [13 - 17.5]	12.4 [9.6 - 15.3]	96.1	43.0	172	1,256	16.4 [13.3 - 19.8]	12.5 [19.6 - 1.5]	7	1,663	14 [11.9 - 16.4]	11 [14.5 - 5.5]
2013-14	SUMMER	Iowa	55	51	4	0	818	39.5 [30.3 - 49.3]	10.8 [5.7 - 16]	96.4	88.5	53	724	43.3 [33.6 - 53.3]	10.8 [19.8 - 2.7]	2	(D)	(D)	(D)
2013-14	SUMMER	Kansas	38	36	2	0	365	10.5 [6.7 - 15.5]	12.1 [6.9 - 17.3]	97.4	74.0	37	270	13.2 [8.6 - 19]	12.3 [16.5 - 2.7]	1	(D)	(D)	(D)
2013-14	SUMMER	Kentucky	96	91	5	0	1,097	12.8 [9.4 - 16.8]	16.5 [11.9 - 21.1]	95.8	74.6	92	818	15.6 [11.6 - 20.2]	17 [23.3 - 2.4]	4	(D)	(D)	(D)
2013-14	SUMMER	Louisiana	23	21	0	2	7,802	17.8 [17 - 18.7]	12.8 [6.1 - 19.5]	95.7	29.5	22	2,302	18.5 [16.8 - 20.2]	12.6 [16.8 - 3.6]	1	(D)	(D)	(D)
2013-14	SUMMER	Maine	141	135	2	4	27,162	23.1 [20.3 - 26]	8.3 [5.7 - 10.8]	95.7	2.3	135	623	9.3 [7.2 - 11.6]	7.6 [15.1 - 1.3]	6	26,539	23.5 [11 - 40.2]	22.8 [20.1 - 8.2]
2013-14	SUMMER	Maryland	158	153	3	2	13,252	31.9 [30.6 - 33.1]	18.1 [13.9 - 22.3]	92.4	8.2	146	1,084	16.1 [13.8 - 18.6]	18.4 [27.6 - 2.3]	12	12,168	33.6 [31.4 - 35.8]	14.4 [17.8 - 5.1]
2013-14	SUMMER	Massachusetts	151	147	2	2	7,463	2.5 [1.4 - 4.1]	16 [12.1 - 19.9]	95.4	18.2	144	1,360	13.3 [11 - 15.8]	16.6 [24.8 - 2.1]	7	6,103	#VALUE!	3.8 [6.6 - 2.5]
2013-14	SUMMER	Michigan	340	320	10	10	22,868	19.3 [17.5 - 21.1]	13.1 [10.8 - 15.4]	96.2	11.8	327	2,696	12.7 [10.8 - 14.9]	12.6 [21.4 - 1.2]	13	20,172	20.4 [12.1 - 30.8]	26.1 [25.3 - 7]
2013-14	SUMMER	Minnesota	95	78	7	10	69,640	14.4 [12.8 - 16.2]	17.4 [12.7 - 22.1]	86.3	2.4	82	1,670	21.1 [17.8 - 24.7]	16.6 [24.3 - 2.7]	13	67,970	14.2 [10.1 - 19.1]	22.4 [16.5 - 4.6]
2013-14	SUMMER	Mississippi	26	18	2	6	70,611	25.2 [16.1 - 36.2]	17.9 [6.9 - 29]	69.2	0.3	18	206	4.9 [1 - 13.3]	10.1 [25.5 - 6]	8	70,405	25.3 [9.8 - 46.8]	35.6 [29.4 - 10.4]
2013-14	SUMMER	Missouri	83	79	4	0	1,137	10.4 [8.1 - 13.1]	17.5 [12.4 - 22.6]	98.8	91.2	82	1,037	10.6 [8.1 - 13.5]	17.6 [23.8 - 2.6]	1	(D)	(D)	(D)
2013-14	SUMMER	Montana	23	17	1	5	25,793	10.4 [9 - 11.9]	13.6 [6 - 21.1]	69.6	0.2	16	53	21.2 [11.8 - 33.3]	12.4 [20 - 5]	7	25,740	10.4 [8.1 - 13]	16.2 [15.5 - 5.9]
2013-14	SUMMER	Nebraska	11	8	1	2	53,652	10.5 [8.4 - 12.9]	22 [6.2 - 37.8]	72.7	0.1	8	37	22.7 [8 - 44.2]	21.3 [28.1 - 9.9]	3	(D)	(D)	(D)
2013-14	SUMMER	Nevada	12	10	2	0	424	4.7 [2.5 - 8]	4.2 [-0.3 - 8.7]	83.3	8.7	10	37	2.6 [0.3 - 9]	3.6 [8.3 - 2.6]	2	(D)	(D)	(D)
2013-14	SUMMER	New Hampshire	57	57	0	0	174	8.7 [5.1 - 13.4]	8.6 [4.4 - 12.8]	96.5	89.7	55	156	8.9 [5.2 - 13.8]	8.5 [16.4 - 2.2]	2	(D)	(D)	(D)
2013-14	SUMMER	New Jersey	171	164	5	2	16,953	29.1 [27.9 - 30.4]	10.7 [7.5 - 13.9]	96.5	5.2	165	885	12.4 [10.1 - 14.9]	10.6 [21.5 - 1.7]	6	16,068	30.3 [25.2 - 35.7]	12.8 [13.4 - 5.5]
2013-14	SUMMER	New Mexico	18	18	0	0	59	8.6 [3.8 - 16.1]	7.9 [-0.1 - 16]	100.0	100.0	18	59	8.6 [3.8 - 16.1]	7.9 [17.4 - 4.1]	0			
2013-14	SUMMER	New York	165	148	11	6	22,029	27.6 [25.1 - 30.1]	12.3 [9.3 - 15.4]	93.3	9.1	154	2,000	7.3 [5.4 - 9.6]	12 [20.4 - 1.6]	11	20,029	30.3 [21.9 - 39.7]	17.5 [16.6 - 5]
2013-14	SUMMER	North Carolina	260	253	5	2	45,056	12 [11.3 - 12.9]	19.4 [16.2 - 22.7]	94.2	3.5	245	1,595	17.5 [15 - 20.3]	19.4 [27.1 - 1.7]	15	43,461	11.9 [9.2 - 15.1]	20.4 [21.6 - 5.6]
2013-14	SUMMER	North Dakota	26	1	2	23	128,819	26.1 [17.9 - 35.6]	23 [15.2 - 30.9]	3.8	0.0	1	(D)	(D)	(D)	25	128,818	26.1 [17.7 - 35.8]	24 [20.3 - 4.1]
2013-14	SUMMER	Ohio	416	412	3	1	14,106	29.7 [28.6 - 30.8]	15.5 [13.2 - 17.7]	97.6	13.4	406	1,893	13.9 [12.1 - 15.7]	15.5 [23.5 - 1.2]	10	12,213	33.1 [31 - 35.3]	16.4 [18.3 - 5.8]
2013-14	SUMMER	Oklahoma	26	25	0	1	4,718	25.3 [23.3 - 27.4]	11.4 [4.2 - 18.5]	96.2	2.5	25	118	5.4 [1.6 - 12.5]	10.8 [18.8 - 3.8]	1	(D)	(D)	(D)
2013-14	SUMMER	Oregon	176	164	3	9	34,975	19.6 [17.4 - 21.9]	13.8 [10.5 - 17.1]	92.0	1.6	162	552	15 [11.8 - 18.6]	13.3 [22.7 - 1.8]	14	34,423	19.7 [12.5 - 28.5]	20.4 [19.1 - 5.1]
2013-14	SUMMER	Pennsylvania	857	837	16	4	23,575	27.1 [25.9 - 28.2]	14.5 [12.9 - 16.2]	97.9	18.6	839	4,378	12.5 [11.2 - 13.9]	14.5 [24.6 - 0.9]	18	19,197	30.9 [24.3 - 38]	16.2 [20.4 - 4.8]
2013-14	SUMMER	Puerto Rico	0																
2013-14	SUMMER	Rhode Island	22	21	1	0	119	6.1 [2.9 - 10.9]	8 [1.4 - 14.6]	72.7	52.9	16	63	4.9 [0.7 - 15.1]	6.8 [18.1 - 4.5]	6	56	6.9 [3.7 - 11.3]	11 [7.2 - 3]
2013-14	SUMMER	South Carolina	159	153	4	2	4,350	19.2 [17.3 - 21.2]	20.5 [15.8 - 25.3]	96.2	22.8	153	992	16.8 [13.3 - 20.8]	20.9 [30.8 - 2.5]	6	3,358	20 [16.3 - 24.1]	11.6 [11.9 - 4.9]
2013-14	SUMMER	South Dakota	15	8	1	6	58,410	13.6 [9.5 - 18.6]	18.7 [8.2 - 29.1]	46.7	0.0	7	22	5.9 [0.4 - 22]	10 [19.1 - 7.2]	8	58,388	13.6 [8.1 - 20.9]	26.2 [19.9 - 7]
2013-14	SUMMER	Tennessee	94	90	4	0	1,020	36.8 [30.1 - 43.9]	18.9 [13.4 - 24.5]	94.7	55.1	89	562	18.6 [14.2 - 23.7]	18.7 [27.1 - 2.9]	5	458	65.4 [36.5 - 88]	23.1 [33.7 - 15.1]
2013-14	SUMMER	Texas	80	56	7	17	117,086	23.4 [18.6 - 28.6]	17.9 [12.9 - 23]	75.0	2.2	60	2,624	29.7 [26.5 - 33.1]	15.2 [22.7 - 2.9]	20	114,462	23.2 [14 - 34.5]	26.2 [22.7 - 5.1]
2013-14	SUMMER	Utah	55	47	5	3	4,409	15.2 [12.4 - 18.3]	17.2 [10.1 - 24.2]	83.6	4.0	46	178	13.4 [8 - 20.4]	18.3 [28.7 - 4.2]	9	4,231	15.2 [8.8 - 23.7]	11.1 [10.6 - 3.5]
2013-14	SUMMER	Vermont	82	79	2	1	1,317	20.2 [18 - 22.4]	15.1 [10.6 - 19.7]	95.1	98.2	78	1,293	20.3 [18 - 22.6]	15.4 [21.5 - 2.4]	4	(D)	(D)	(D)
2013-14	SUMMER	Virginia	662	648	13	1	16,043	28.2 [27.2 - 29.2]	15.5 [13.7 - 17.4]	98.2	23.8	650	3,814	15.5 [14 - 17.1]	15.7 [24.5 - 1]	12	12,229	33 [31.5 - 34.6]	6.9 [11.9 - 3.4]
2013-14	SUMMER	Washington	123	106	9	8	44,946	25.2 [22.8 - 27.7]	15.1 [11.1 - 19.2]	89.4	1.6	110	724	11.8 [8.8 - 15.4]	14 [23.4 - 2.2]	13	44,222	25.5 [18.4 - 33.5]	24.6 [18.3 - 5.1]
2013-14	SUMMER	West Virginia	65	60	5	0	867	6.4 [4.3 - 9.1]	10.4 [6.1 - 14.8]	90.8	63.4	59	550	7.6 [5 - 10.9]	10.8 [18.4 - 2.4]	6	317	4 [1.1 - 9.7]	6.8 [8.6 - 3.5]
2013-14	SUMMER	Wisconsin	138	114	13	11	37,324	22.1 [20 - 24.3]	12.1 [8.8 - 15.4]	85.5	3.4	118	1,264	14.6 [11.6 - 17.9]	11.4 [19.9 - 1.8]	20	36,060	22.5 [17.3 - 28.3]	16.4 [18.9 - 4.2]
2013-14	SUMMER	Wyoming	10	5	1	4	14,184	9.2 [4.2 - 16.7]	8.6 [2.5 - 14.8]	40.0	0.1	4	(D)	(D)	(D)	6	14,171	9.2 [3.1 - 19.8]	13 [10.4 - 4.3]
2013-14	SUMMER	Other	0																
2013-14	SUMMER	MultiStateOperation	189	73	37	79	324,366	20.6 [18.1 - 23.3]	17.2 [14.5 - 19.9]	0.0	0.0	189	324,366	20.6 [18.1 - 23.3]	17.2 [19 - 1.4]	189	324,366	20.6 [18.1 - 23.3]	17.2 [19 - 1.4]
2014-15	SUMMER	Alabama	29	28	1	0	308	21.2 [12.8 - 31.6]	16.6 [8.9 - 24.3]	96.6	98.7	28	304	21.3 [12.7 - 32.1]	16.6 [21.5 - 4.1]	1	(D)	(D)	(D)
2014-15	SUMMER	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)

SurveyYear	Season	State	All operations in the State: N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State: N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations: N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2014-15	SUMMER	Arizona	9	7	1	1	424	12 [8.1 - 16.8]	7 [-2.3 - 16.3]	88.9	62.3	8	264	9.8 [3.9 - 19.2]	6.2 [15 - 5.3]	1	(D)	(D)	(D)
2014-15	SUMMER	Arkansas	100	96	3	1	1,995	37.4 [33.4 - 41.5]	16.5 [11.5 - 21.4]	94.0	76.0	94	1,470	35.9 [31.7 - 40.2]	16.3 [25.5 - 2.6]	6	465	42.8 [28.4 - 58.2]	18.5 [23 - 9.4]
2014-15	SUMMER	California	199	124	19	56	285,926	23.3 [21 - 25.7]	18.9 [15.6 - 22.1]	64.3	11.8	128	33,759	10 [8.2 - 12.1]	16.5 [25.2 - 2.2]	71	252,167	24.6 [20.8 - 28.7]	23.2 [20.2 - 2.4]
2014-15	SUMMER	Colorado	190	188	1	1	44,693	25.7 [25.3 - 26.2]	17.8 [13.8 - 21.8]	97.9	1.5	186	669	17.5 [14 - 21.3]	18 [28.4 - 2.1]	4	(D)	(D)	(D)
2014-15	SUMMER	Connecticut	56	54	2	0	334	9 [4.9 - 14.8]	13.8 [8.1 - 19.5]	94.6	65.9	53	220	16.1 [10.6 - 22.9]	14.5 [22.1 - 3]	3	(D)	(D)	(D)
2014-15	SUMMER	District of Columbia	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2014-15	SUMMER	Delaware	16	13	1	2	18,291	46.6 [44.3 - 48.8]	17.8 [8.7 - 26.9]	62.5	0.2	10	31	22.5 [15.6 - 30.6]	14.3 [15.4 - 4.9]	6	18,260	46.6 [42.9 - 50.3]	23.6 [23.4 - 9.6]
2014-15	SUMMER	Florida	100	77	16	7	35,732	37.1 [34 - 40.3]	20.8 [16 - 25.6]	85.0	6.6	85	2,348	32.4 [27.9 - 37.1]	19 [25.1 - 2.7]	15	33,384	37.4 [29.7 - 45.6]	31.1 [17.9 - 4.6]
2014-15	SUMMER	Georgia	74	65	7	2	4,347	20.6 [16.7 - 24.9]	16.4 [11.7 - 21]	86.5	27.4	64	1,192	16.7 [12 - 22.3]	14.7 [19.6 - 2.5]	10	3,155	22.7 [13.6 - 34]	27.1 [22.3 - 7]
2014-15	SUMMER	Hawaii	30	21	4	5	14,716	14.3 [10.6 - 18.6]	15.4 [7.3 - 23.5]	96.7	59.2	29	8,716	6.9 [3.9 - 11.2]	15.1 [23.1 - 4.3]	1	(D)	(D)	(D)
2014-15	SUMMER	Idaho	55	38	1	16	84,225	14.9 [11.6 - 18.7]	13.4 [7.7 - 19.1]	69.1	0.2	38	161	13.5 [8.3 - 20.2]	12.7 [24.6 - 4]	17	84,064	14.9 [9.2 - 22.2]	14.9 [13.6 - 3.3]
2014-15	SUMMER	Illinois	105	104	1	0	756	26.6 [22.9 - 30.5]	16.5 [11.9 - 21.1]	97.1	57.4	102	434	18.5 [15 - 22.5]	16.4 [24.3 - 2.4]	3	(D)	(D)	(D)
2014-15	SUMMER	Indiana	97	96	1	0	510	23.7 [18.4 - 29.7]	12.4 [8.2 - 16.6]	96.9	97.8	94	499	24.1 [18.6 - 30.2]	12.7 [21.4 - 2.2]	3	(D)	(D)	(D)
2014-15	SUMMER	Iowa	36	33	3	0	569	29 [18.7 - 41]	11.9 [5.5 - 18.2]	94.4	63.1	34	359	38.3 [27.1 - 50.3]	11.5 [19.4 - 3.3]	2	(D)	(D)	(D)
2014-15	SUMMER	Kansas	40	38	2	0	907	23.2 [18.9 - 27.9]	11.1 [5.7 - 16.5]	97.5	85.1	39	772	25.5 [21.3 - 30.1]	11.2 [17.6 - 2.8]	1	(D)	(D)	(D)
2014-15	SUMMER	Kentucky	60	58	2	0	478	18.8 [13.4 - 25]	20.8 [13.7 - 27.9]	98.3	74.9	59	358	19.2 [13.1 - 26.4]	20.9 [28.3 - 3.7]	1	(D)	(D)	(D)
2014-15	SUMMER	Louisiana	20	17	1	2	8,920	21.3 [19 - 23.7]	24.9 [11.3 - 38.5]	80.0	4.1	16	362	11.2 [3.6 - 24.4]	27.4 [34.1 - 8.5]	4	(D)	(D)	(D)
2014-15	SUMMER	Maine	103	99	2	2	18,582	46.3 [45.2 - 47.4]	10.9 [7.2 - 14.6]	96.1	2.3	99	422	10.8 [7.9 - 14.2]	10 [18.5 - 1.9]	4	(D)	(D)	(D)
2014-15	SUMMER	Maryland	132	129	2	1	9,767	44.5 [42.8 - 46.2]	15.7 [11.4 - 20.1]	94.7	4.9	125	480	16.4 [12.5 - 20.7]	15.8 [25.8 - 2.3]	7	9,287	45.8 [40.8 - 50.9]	14.9 [18.1 - 6.8]
2014-15	SUMMER	Massachusetts	152	148	4	0	789	10.7 [8.2 - 13.7]	14 [10.6 - 17.4]	98.0	78.2	149	617	13.8 [11 - 16.9]	14.9 [21.3 - 1.7]	3	(D)	(D)	(D)
2014-15	SUMMER	Michigan	216	208	7	1	8,078	12.8 [11 - 14.8]	15.3 [12.1 - 18.5]	98.1	92.9	212	7,507	9.3 [8.2 - 10.5]	15.1 [23.8 - 1.6]	4	(D)	(D)	(D)
2014-15	SUMMER	Minnesota	85	70	5	10	76,031	38.5 [33 - 44.1]	20.2 [13.9 - 26.5]	78.8	0.4	67	268	12.3 [7.9 - 17.9]	18.2 [29.7 - 3.6]	18	75,763	38.6 [26.9 - 51.3]	27.7 [28.8 - 6.8]
2014-15	SUMMER	Mississippi	13	10	1	2	12,766	44.3 [40.8 - 47.7]	34.9 [21.1 - 48.6]	84.6	1.3	11	166	15.7 [8 - 26.3]	33 [27.3 - 8.2]	2	(D)	(D)	(D)
2014-15	SUMMER	Missouri	96	90	6	0	1,142	10.5 [8.2 - 13.3]	13.8 [9.8 - 17.8]	96.9	97.0	93	1,108	10.9 [8.5 - 13.7]	14.2 [20.4 - 2.1]	3	(D)	(D)	(D)
2014-15	SUMMER	Montana	27	18	1	8	32,058	16 [11.4 - 21.6]	12.3 [6.1 - 18.5]	70.4	5.5	19	1,769	20.2 [17.1 - 23.4]	11.3 [17.7 - 4.1]	8	30,289	15.8 [7.6 - 27.4]	14.6 [13.5 - 4.8]
2014-15	SUMMER	Nebraska	12	10	0	2	52,112	24.2 [21.5 - 26.9]	26.3 [14.4 - 38.2]	75.0	0.1	9	67	14.5 [6.3 - 26.7]	22.7 [17.1 - 5.7]	3	(D)	(D)	(D)
2014-15	SUMMER	Nevada	9	7	1	1	1,464	27.6 [21.5 - 34.3]	22.1 [5.3 - 38.8]	55.6	1.9	5	28	40.8 [20.5 - 63.6]	20.3 [25.7 - 11.5]	4	(D)	(D)	(D)
2014-15	SUMMER	New Hampshire	43	42	1	0	206	7.9 [3.9 - 13.6]	12.9 [5.8 - 19.9]	90.7	63.6	39	131	13.6 [7.9 - 21]	14.1 [24.5 - 3.9]	4	(D)	(D)	(D)
2014-15	SUMMER	New Jersey	93	92	1	0	475	14.3 [11.2 - 17.9]	8.7 [5.6 - 11.8]	95.7	84.8	89	403	10.2 [7.5 - 13.4]	8.4 [15.1 - 1.6]	4	(D)	(D)	(D)
2014-15	SUMMER	New Mexico	21	20	0	1	1,586	5.6 [3.9 - 7.5]	7.7 [0.5 - 14.9]	95.2	5.4	20	86	10.2 [4.4 - 19]	7.8 [17.2 - 3.8]	1	(D)	(D)	(D)
2014-15	SUMMER	New York	149	134	9	6	24,610	38 [35.1 - 41]	12.8 [9.3 - 16.4]	93.3	8.7	139	2,150	4.9 [3.1 - 7.1]	12.2 [22.2 - 1.9]	10	22,460	41 [31.2 - 51.3]	20.7 [22.4 - 7.1]
2014-15	SUMMER	North Carolina	277	273	4	0	1,938	15.5 [13.1 - 18]	15.9 [13 - 18.7]	96.8	97.1	268	1,882	15.6 [13.2 - 18.2]	15.7 [24.3 - 1.5]	9	56	12.8 [3.8 - 28.3]	20.2 [24.1 - 8]
2014-15	SUMMER	North Dakota	34	5	2	27	175,813	23.5 [18.5 - 29.1]	23.6 [16.1 - 31.1]	8.8	0.0	3	(D)	(D)	(D)	31	175,801	23.5 [18.3 - 29.4]	21.4 [18.2 - 3.3]
2014-15	SUMMER	Ohio	275	269	6	0	1,940	20.2 [17.5 - 23.1]	12.4 [9.8 - 15.1]	97.5	71.3	268	1,384	10.8 [8.7 - 13.2]	12.3 [22.3 - 1.4]	7	556	48 [38.7 - 57.4]	16.6 [26.1 - 9.9]
2014-15	SUMMER	Oklahoma	38	34	1	3	8,026	57 [54.2 - 59.7]	20.4 [12 - 28.8]	89.5	3.0	34	244	16.4 [10.9 - 23.2]	17.3 [25.7 - 4.4]	4	(D)	(D)	(D)
2014-15	SUMMER	Oregon	152	143	1	8	38,020	14 [12.2 - 15.9]	12.9 [9.5 - 16.3]	94.1	23.1	143	8,799	23.9 [21.8 - 26.1]	13.1 [21.8 - 1.8]	9	29,221	9.4 [5 - 15.5]	10.5 [13.4 - 4.5]
2014-15	SUMMER	Pennsylvania	693	679	12	2	22,075	42.2 [41.1 - 43.2]	13.2 [11.6 - 14.9]	98.6	15.8	683	3,479	14.6 [13.3 - 16.1]	12.8 [21.6 - 0.8]	10	18,596	47.1 [45.8 - 48.3]	42.1 [22.6 - 7.1]
2014-15	SUMMER	Puerto Rico	0																
2014-15	SUMMER	Rhode Island	22	20	2	0	193	2.8 [0.5 - 7.9]	7.6 [1.6 - 13.6]	72.7	36.8	16	71	10.7 [5.1 - 18.8]	10.5 [16 - 4]	6	122	#VALUE!	0 [0 - 0]
2014-15	SUMMER	South Carolina	74	69	4	1	2,009	9.4 [6.2 - 13.5]	16.9 [11.4 - 22.4]	89.2	25.7	66	516	21.3 [16.3 - 26.9]	16.3 [24.2 - 3]	8	1,493	3.8 [0.6 - 11.6]	21.8 [24.3 - 8.6]
2014-15	SUMMER	South Dakota	17	8	0	9	67,434	23.8 [19.1 - 29]	15.8 [6.4 - 25.2]	47.1	2.7	8	1,817	68.5 [64 - 72.7]	14.9 [28 - 9.9]	9	65,617	22.6 [18.1 - 27.5]	16.6 [9.8 - 3.3]
2014-15	SUMMER	Tennessee	78	72	6	0	1,045	21.7 [16.6 - 27.4]	16.3 [10.3 - 22.4]	96.2	74.4	75	777	13.1 [9.7 - 17.1]	15.9 [27.3 - 3.2]	3	(D)	(D)	(D)
2014-15	SUMMER	Texas	152	130	4	18	114,435	32.8 [29.1 - 36.6]	13.6 [10.4 - 16.8]	84.2	2.7	128	3,100	30 [27.1 - 33.1]	11 [19 - 1.7]	24	111,335	32.8 [23.8 - 42.8]	27.4 [19.9 - 4.1]
2014-15	SUMMER	Utah	45	38	3	4	13,875	19.9 [18.6 - 21.2]	17.7 [10.2 - 25.1]	82.2	1.1	37	154	17.4 [11.2 - 25]	15.4 [26.6 - 4.4]	8	13,721	19.9 [17.2 - 22.8]	28 [17.3 - 6.1]
2014-15	SUMMER	Vermont	51	47	4	0	361	7.5 [4.8 - 10.9]	9.7 [4.5 - 14.9]	92.2	72.3	47	261	8.1 [4.9 - 12.4]	9.7 [19.6 - 2.9]	4	(D)	(D)	(D)
2014-15	SUMMER	Virginia	614	606	8	0	2,923	15 [13.5 - 16.7]	15 [13.1 - 16.8]	98.4	97.9	604	2,861	15.1 [13.5 - 16.7]	15 [23.7 - 1]	10	62	12.5 [3.4 - 28.9]	11.1 [19.2 - 6.1]
2014-15	SUMMER	Washington	131	119	2	10	86,530	24.7 [22.9 - 26.5]	13.2 [9.8 - 16.5]	91.6	0.7	120	612	13.6 [10.8 - 16.7]	12.8 [20 - 1.8]	11	85,918	24.7 [18.8 - 31.4]	16.9 [15.2 - 4.6]
2014-15	SUMMER	West Virginia	50	49	1	0	474	7.1 [4.4 - 10.7]	13.8 [6.4 - 21.2]	88.0	40.7	44	193	6.9 [2.9 - 13.3]	15.1 [28.2 - 4.2]	6	281	7.3 [5.5 - 9.4]	4 [4.6 - 1.9]
2014-15	SUMMER	Wisconsin	125	111	11	3	20,945	45.4 [43.9 - 46.9]	19.3 [15.2 - 23.5]	92.8	8.0	116	1,685	28.9 [24.5 - 33.5]	18.9 [23.7 - 2.2]	9	19,260	46.7 [44.7 - 48.8]	24.9 [21.3 - 7.1]
2014-15	SUMMER	Wyoming	13	9	0	4	12,730	19.1 [16.5 - 21.8]	29.2 [13.1 - 45.4]	69.2	0.2	9	30	36.4 [15.8 - 61.2]	34.3 [34.9 - 11.6]	4	(D)	(D)	(D)
2014-15	SUMMER	Other	0																
2014-15	SUMMER	MultiStateOperation	155	67	30	58	275,058	28 [24.7 - 31.6]	19.8 [16.5 - 23.1]	0.0	0.0	155	275,058	28 [24.7 - 31.6]	19.8 [20.7 - 1.7]	155	275,058	28 [24.7 - 31.6]	19.8 [20.7 - 1.7]
2015-16	SUMMER	Alabama	46	46	0	0	374	14 [8.6 - 20.9]	16.3 [9 - 23.6]	97.8	96.5	45	361	13.3 [7.9 - 20.4]	15.9 [25.4 - 3.8]	1	(D)	(D)	(D)
2015-16	SUMMER	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2015-16	SUMMER	Arizona	7	7	0	0	35	19.5 [2.8 - 52.2]	29.5 [-0.6 - 59.7]	100.0	100.0	7	35	19.5 [2.8 - 52.2]	29.5 [40.7 - 15.4]	0			
2015-16	SUMMER	Arkansas	40	39	0	1	1,050	43.9 [39.1 - 48.9]	14.9 [7.3 - 22.5]	92.5	21.2	37	223	16.8 [11.2 - 23.5]	14.1 [24.5 - 4]	3	(D)	(D)	(D)
2015-16	SUMMER	California	202	122	14	66	308,540	23.4 [20.9 - 25.9]	22 [18.5 - 25.4]	64.9	6.5	131	20,035	16.6 [12.8 - 21.1]	21.9 [27.6 - 2.4]	71	288,505	23.8 [19.9 - 28.1]	22.2 [20 - 2.4]
2015-16	SUMMER	Colorado	138	135	2	1	2,762	10.7 [9 - 12.6]	19.5 [14.8 - 24.2]	97.1	19.6	134	541	14 [10.7 - 17.8]	19.8 [28.6 - 2.5]	4	(D)	(D)	(D)
2015-16	SUMMER	Connecticut	69	67	2	0	566	9 [5.9 - 12.9]	15.1 [8.9 - 21.2]	94.2	96.3	65	545	9.1 [5.9 - 13.1]	15.4 [26.4 - 3.3]	4	(D)	(D)	(D)
2015-16	SUMMER	District of Columbia	7	6	1	0	85	10.9 [5.2 - 19.2]	20.3 [-6.5 - 47]	71.4	12.9	5	11	20 [4.2 - 47.9]	24.4 [43.3 - 19.4]	2	(D)	(D)	(D)
2015-16	SUMMER	Delaware	23	21	0	2	10,280	41.5 [38.7 - 44.4]	12.6 [3.3 - 21.9]	78.3	0.7	18	69	17.1 [9.3 - 27.5]	12.8 [24.3 - 5.7]	5	10,211	41.7 [35.6 - 48]	11.9 [17.8 - 8]
2015-16	SUMMER	Florida	66	55	4	7	32,598	30.2 [26.9 - 33.6]	20 [14 - 26.1]	89.4	14.7	59	4,798	40 [37.3 - 42.7]	20.1 [26.1 - 3.4]	7	27,800	28.2 [18.4 - 39.6]	19.4 [13.7 - 5.2]
2015-16	SUMMER	Georgia	73	69	3	1	1,512	37.4 [32.4 - 42.5]	19 [13 - 25.1]	91.8	31.9	67	483	19.9 [14.7 - 26]	19.1 [26.9 - 3.3]	6	1,029	45.3 [31.9 - 59.2]	18.5 [20.8 - 8.5]
2015-16	SUMMER	Hawaii	57	52	3	2	4,674	27.8 [21.8 - 34.5]	18.7 [11.3 - 26.2]	98.2	99.9	56	4,668	27.8 [21.7 - 34.5]	19.1 [28.8 - 3.9]	1	(D)	(D)	(D)
2015-16	SUMMER	Idaho	46	28	1	17	96,127	20.8 [16.2 - 25.9]	16.9 [11.3 - 22.5]	60.9	1.1	28	1,069	9.8 [6.9 - 13.4]	16.6 [20.7 - 3.9]	18	95,058	20.9 [13.8 - 29.4]	17.3 [18.1 - 4.3]
2015-16	SUMMER	Illinois	129	127	2	0	736	16.5 [13.2 - 20.2]	15.2 [11.4 - 19]	96.9	97.4	125	717	16.1 [12.7 - 19.8]	15 [22.2 - 2]	4	(D)	(D)	(D)
2015-16	SUMMER	Indiana	157	153	4	0	1,011	19.6 [16.3 - 23.2]	14 [10.3 - 17.7]	98.7	98.5	155	996	19.4 [16.1 - 23]	13.9 [23.8 - 1.9]	2	(D)	(D)	(D)
2015-16	SUMMER	Iowa	49	46	3	0	543	32.1 [23.7 - 41.5]	22.2 [15.1 - 29.3]	95.9	64.1	47	348	41.8 [33.6 - 50.3]	21.3 [23.9 - 3.5]	2	(D)	(D)	(D)
2015-16	SUMMER	Kansas	34	31	2	1	3,242	30.3 [26.4 - 34.5]	14 [7.1 - 20.9]	97.1	13.6	33	442	45.2 [35.7 - 55]	13.5 [20.7 - 3.6]	1	(D)	(D)	(D)
2015-16	SUMMER	Kentucky	75	72	3	0	400	15.9 [11.4 - 21.3]	16.7 [11.2 - 22.2]	98.7	99.8	74	399	16.1 [11.5 - 21.5]	16.9 [24.3 - 2.8]	1	(D)	(D)	(D)
2015-16	SUMMER	Louisiana	24	22	2	0	591	6.4 [3 - 11.6]	18.6 [6.8 - 30.5]	100.0	100.0	24	591	6.4 [3 - 11.6]	18.6 [29.6 - 6]	0			
2015-16	SUMMER	Maine	82	78	2	2	29,883	29.3 [26.8 - 31.9]	11.1 [7.3 - 14.9]	96.3	1.3	79	377	10.7 [7.8 - 14]	10.7 [17.6 - 2]	3	(D)	(D)	(D)
2015-16	SUMMER	Maryland	131	122	5	4	13,629	35.8 [33.5 - 38.2]	13.8 [10 - 17.6]	93.1	9.8	122	1,330	17.6 [14.8 - 20.5]	13.8 [22.6 - 2]	9	12,299	37.6 [29.7 - 46]	14.3 [14 - 4.7]
2015-16	SUMMER	Massachusetts	114	113	0	1	1,015	13.2 [10.8 - 15.9]	14.2 [10.1 - 18.3]	95.6	96.7	109	982	13.2 [10.7 - 16]	14.4 [22.8 - 2.2]	5	33	13 [3.7 - 29.4]	10.7 [15.3 - 6.9]
2015-16	SUMMER	Michigan	199	189	8	2	3,544	27.9 [25.4 - 30.6]	15.6 [12.5 - 18.7]	98.5	31.0	196	1,099	16.8 [14 - 19.9]	15.3 [22.3 - 1.6]	3	(D)	(D)	(D)
2015-16	SUMMER	Minnesota	116	100	8	8	36,832	32 [28.6 - 35.5]	17.7 [12.9 - 22.4]	87.9	4.5	102	1,659	48.2 [42.8 - 53.7]	16.6 [26.6 - 2.6]	14	35,173	30.3 [21.7 - 39.9]	25.2 [18.6 - 5]
2015-16	SUMMER	Mississippi	12	10	0	2	12,148	55.2 [50.6 - 59.6]	15 [2.8 - 27.2]	66.7	0.4	8	43	11.4 [4.1 - 23.1]	8.8 [12.5 - 4.4]	4	(D)	(D)	(D)
2015-16	SUMMER	Missouri	126	126	0	0	655	14.8 [11.7 - 18.4]	15.7 [11.4 - 20]	98.4	97.3	124	637	15 [11.8 - 18.7]	15.8 [24.8 - 2.2]	2	(D)	(D)	(D)
2015-16	SUMMER	Montana	19	8	1	10	39,691	8.4 [4.5 - 13.9]	21.3 [7.3 - 35.4]	36.8	0.2	7	60	16.4 [3.1 - 41.8]	31.9 [43.6 - 16.5]	12	39,631	8.4 [3.6 - 15.6]	15.2 [21.2 - 6.1]
2015-16	SUMMER	Nebraska	16	12	1	3	25,727	21.5 [13.5 - 31.2]	13.5 [4.2 - 22.8]	81.3	0.5	13	127	4.3 [0.8 - 12.1]	11.2 [18.4 - 5.1]	3	(D)	(D)	(D)
2015-16	SUMMER	Nevada	5	4	0	1	2,415	26.7 [25 - 28.4]	26 [6.2 - 45.8]	80.0	0.6	4	(D)	(D)	(D)	1	(D)	(D)	(D)
2015-16	SUMMER	New Hampshire	49	49	0	0	157	11.7 [7.9 - 16.3]	9.9 [4.7 - 15]	89.8	86.0	44	135	11.1 [7.1 - 16.2]	9.4 [19 - 2.9]	5	22	14.9 [5.7 - 29.2]	13.5 [14.1 - 6.3]
2015-16	SUMMER	New Jersey	114	108	4	2	7,237	12.6 [11.3 - 14]	11.3 [7.9 - 14.8]	90.4	11.8	103	852	16.9 [13.7 - 20.5]	11.7 [19.5 - 1.9]	11	6,385	11.9 [10.7 - 13.1]	8.4 [11.5 - 3.5]
2015-16	SUMMER	New Mexico	17	17	0	0	77	7.4 [1.6 - 19.1]	10.5 [-0.4 - 21.4]	88.2	92.2	15	71	7.7 [1.6 - 20.6]	11.9 [24.1 - 6.2]	2	(D)	(D)	(D)
2015-16	SUMMER	New York	148	138	3	7	19,781	27.8 [25.2 - 30.6]	10.9 [7.9 - 14]	92.6	7.0	137	1,383	10.8 [9 - 12.8]	11.2 [19.3 - 1.6]	11	18,398	29.2 [19.8 - 40.1]	8.4 [12.5 - 3.8]
2015-16	SUMMER	North Carolina	267	262	3	2	7,084	10.2 [9 - 11.5]	18.6 [15.3 - 21.9]	97.4	23.2	260	1,644	15.6 [13.2 - 18.2]	18.7 [27.6 - 1.7]	7	5,440	8.6 [7.4 - 9.9]	14.5 [13.3 - 5]
2015-16	SUMMER	North Dakota	28	4	0	24	170,427	26.9 [21.3 - 33]	28.1 [21.6 - 34.7]	10.7	0.0	3	(D)	(D)	(D)	25	170,419	26.9 [21 - 33.4]	29 [17.5 - 3.5]
2015-16	SUMMER	Ohio	241	236	5	0	1,459	15.4 [13 - 17.9]	16 [13.1 - 19]	97.5	96.2	235	1,404	15.1 [12.7 - 17.7]	16.1 [23.5 - 1.5]	6	55	22.9 [12.5 - 36.2]	14.4 [15.4 - 6.3]
2015-16	SUMMER	Oklahoma	44	41	2	1	2,443	41.1 [38.3 - 44.1]	28.7 [19.9 - 37.5]	97.7	24.8	43	607	18.1 [13.2 - 23.8]	28.3 [30.1 - 4.6]	1	(D)	(D)	(D)
2015-16	SUMMER	Oregon	137	126	1	10	35,357	21 [18.4 - 23.7]	15.2 [11.5 - 18.9]	90.5	17.7	124	6,269	40 [38.6 - 41.5]	15.3 [22.9 - 2.1]	13	29,088	14.9 [8.7 - 23.1]	14 [13.7 - 3.8]
2015-16	SUMMER	Pennsylvania	619	612	6	1	12,744	36.5 [35.4 - 37.7]	14.4 [12.5 - 16.3]	98.4	19.5	609	2,484	14.4 [12.9 - 16.1]	14.3 [24.5 - 1]	10	10,260	42.1 [38.9 - 45.4]	19.7 [17.5 - 5.5]
2015-16	SUMMER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2015-16	SUMMER	Rhode Island	19	19	0	0	55	5.3 [0.9 - 15.8]	8.2 [-0.8 - 17.3]	84.2	76.4	16	42	7.1 [1.4 - 19.7]	9.8 [21.6 - 5.4]	3	(D)	(D)	(D)
2015-16	SUMMER	South Carolina	107	103	3	1	1,850	13.7 [10.4 - 17.5]	23.5 [17.9 - 29.1]	96.3	31.4	103	580	22.6 [17.7 - 27.9]	24.1 [30 - 3]	4	(D)	(D)	(D)
2015-16	SUMMER	South Dakota	14	7	0	7	57,023	26.1 [18.6 - 34.7]	28.1 [13.2 - 42.9]	42.9	0.0	6	28	8.6 [0.6 - 31.5]	28.3 [39.7 - 16.2]	8	56,995	26.2 [16.2 - 38.1]	27.9 [19.4 - 6.8]
2015-16	SUMMER	Tennessee	104	100	4	0	757	11.8 [8.7 - 15.4]	13.2 [8.9 - 17.6]	97.1	92.2	101	698	11.1 [8 - 14.8]	13.2 [22.9 - 2.3]	3	(D)	(D)	(D)
2015-16	SUMMER	Texas	103	80	4	19	121,023	27.2 [24.1 - 30.5]	19.9 [15.6 - 24.3]	79.6	1.1	82	1,339	31.2 [24.8 - 38.2]	18 [23.2 - 2.6]	21	119,684	27.2 [20.5 - 34.7]	27.4 [19.1 - 4.2]
2015-16	SUMMER	Utah	41	35	3	3	8,712	38.8 [34.3 - 43.5]	23.2 [15.2 - 31.2]	87.8	2.8	36	245	20.5 [15.5 - 26.3]	23 [26.8 - 4.5]	5	8,467	39.4 [26 - 53.9]	24.4 [22.1 - 9.9]
2015-16	SUMMER	Vermont	51	47	2	2	1,388	7.2 [4.9 - 10.2]	12.8 [7 - 18.5]	88.2	49.1	45	681	13.4 [10.8 - 16.3]	13.3 [22 - 3.3]	6	707	0.9 [0 - 10.6]	8.4 [10 - 4.1]
2015-16	SUMMER	Virginia	595	588	7	0	2,722	17.5 [15.8 - 19.3]	17.2 [15 - 19.4]	98.0	87.9	583	2,393	18.1 [16.3 - 20]	17.3 [27.5 - 1.1]	12	329	12.3 [7.3 - 18.7]	12.7 [13.2 - 3.8]
2015-16	SUMMER	Washington	121	112	4	5	27,762	18.4 [16.7 - 20.2]	19.2 [14.4 - 23.9]	93.4	2.8	113	786	20.3 [15.9 - 25.2]	18.7 [26.5 - 2.5]	8	26,976	18.4 [12.5 - 25.4]	25.8 [27.1 - 9.6]
2015-16	SUMMER	West Virginia	57	53	3	1	782	9.2 [6.6 - 12.2]	14.6 [9.4 - 19.8]	91.2	46.7	52	365	10.9 [7 - 15.8]	14.3 [20.6 - 2.9]	5	417	7.9 [5.5 - 10.8]	17.8 [12.2 - 5.5]
2015-16	SUMMER	Wisconsin	127	119	5	3	19,117	32.4 [30 - 34.8]	22.7 [18.3 - 27.1]	95.3	19.3	121	3,698	14.9 [12.9 - 17]	23 [25.7 - 2.3]	6	15,419	35.5 [25.8 - 46]	17.1 [16.7 - 6.8]
2015-16	SUMMER	Wyoming	26	18	2	6	17,210	25.1 [17.7 - 33.7]	17.6 [8.7 - 26.5]	69.2	1.9	18	325	19.2 [13 - 26.7]	18.6 [25.6 - 6]	8	16,885	25.2 [12.3 - 42.1]	15.4 [18.2 - 6.4]
2015-16	SUMMER	Other	0																
2015-16	SUMMER	MultiStateOperation	149	65	12	72	330,353	23.7 [21 - 26.6]	17.7 [14.8 - 20.7]	0.0	0.0	149	330,353	23.7 [21 - 26.6]	17.7 [18.6 - 1.5]	149	330,353	23.7 [21 - 26.6]	17.7 [18.6 - 1.5]
2016-17	SUMMER	Alabama	44	43	1	0	409	16.1 [10.9 - 22.4]	23.9 [16 - 31.8]	97.7	97.8	43	400	15.7 [10.4 - 22.1]	23.7 [27.1 - 4.1]	1	(D)	(D)	(D)
2016-17	SUMMER	Alaska	0																
2016-17	SUMMER	Arizona	11	10	1	0	179	8.7 [4.2 - 15.2]	22.8 [4 - 41.6]	81.8	25.7	9	46	17.5 [5.4 - 37.1]	27 [34 - 11.3]	2	(D)	(D)	(D)

SurveyYear	Season	State	All operations in the State N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2016-17	SUMMER	Arkansas	36	33	1	2	2,286	36.2 [28.4 - 44.6]	22 [13.8 - 30.2]	88.9	13.9	32	317	28.8 [22.3 - 36.1]	20.3 [23 - 4.1]	4	(D)	(D)	(D)
2016-17	SUMMER	California	172	100	22	50	251,386	17.4 [15.1 - 20]	18.9 [15.2 - 22.5]	63.4	19.8	109	49,822	15.1 [13.2 - 17.2]	16.9 [25.6 - 2.4]	63	201,564	18 [13.9 - 22.6]	22.3 [21.9 - 2.8]
2016-17	SUMMER	Colorado	96	94	1	1	2,981	26.7 [20.9 - 32.9]	15.9 [10.6 - 21.2]	93.8	14.6	90	434	22 [17.2 - 27.5]	15.2 [25.7 - 2.7]	6	2,547	27.7 [7.5 - 57.6]	25.9 [37.9 - 15.5]
2016-17	SUMMER	Connecticut	38	37	1	0	354	16.1 [9.9 - 23.9]	21.9 [11.1 - 32.8]	100.0	100.0	38	354	16.1 [9.9 - 23.9]	21.9 [34 - 5.5]	0			
2016-17	SUMMER	District of Columbia	23	23	0	0	75	14.4 [5.2 - 29.1]	15.5 [3.3 - 27.7]	91.3	82.7	21	62	12.2 [3.4 - 28]	12.9 [28.3 - 6.2]	2	(D)	(D)	(D)
2016-17	SUMMER	Delaware	39	38	1	0	344	19.3 [12.2 - 28.2]	17.4 [9.8 - 25]	87.2	84.6	34	291	19.2 [11.2 - 29.3]	17.6 [25.3 - 4.3]	5	53	20.3 [7.3 - 39.6]	16.2 [17.5 - 7.8]
2016-17	SUMMER	Florida	74	56	11	7	46,485	14.4 [10.9 - 18.5]	27.3 [20.9 - 33.6]	83.8	4.8	62	2,229	33.7 [27.6 - 40.3]	26.1 [28.5 - 3.6]	12	44,256	13.7 [6.2 - 24.8]	33.1 [24 - 6.9]
2016-17	SUMMER	Georgia	86	71	8	7	26,067	23.4 [20.6 - 26.3]	21.3 [15.5 - 27]	87.2	9.3	75	2,422	24.1 [21.1 - 27.3]	21.1 [28 - 3.2]	11	23,645	23.3 [15.8 - 32.2]	22.6 [22.1 - 6.7]
2016-17	SUMMER	Hawaii	10	10	0	0	75	#VALUE!	0 [0 - 0]	100.0	100.0	10	75	#VALUE!	0 [0 - 0]	0			
2016-17	SUMMER	Idaho	30	23	1	6	51,283	19.9 [15.4 - 25.1]	13 [7.4 - 18.7]	83.3	1.9	25	951	12.6 [10.5 - 14.9]	10.3 [14.3 - 2.9]	5	50,332	20.1 [9.2 - 35.1]	26.7 [17.3 - 7.7]
2016-17	SUMMER	Illinois	98	97	1	0	472	18.4 [14.9 - 22.2]	18.3 [13.6 - 23.1]	98.0	99.6	96	470	18.1 [14.7 - 22]	18.2 [24 - 2.4]	2	(D)	(D)	(D)
2016-17	SUMMER	Indiana	102	98	4	0	632	13.1 [9.9 - 16.8]	12.5 [8.7 - 16.3]	100.0	100.0	102	632	13.1 [9.9 - 16.8]	12.5 [19.7 - 2]	0			
2016-17	SUMMER	Iowa	72	71	1	0	725	58.4 [50.2 - 66.2]	12.4 [7.7 - 17.2]	97.2	54.6	70	396	42.9 [35.9 - 50]	11.5 [18.5 - 2.2]	2	(D)	(D)	(D)
2016-17	SUMMER	Kansas	18	17	0	1	14,133	15 [14 - 16.1]	26 [10.9 - 41.2]	94.4	0.9	17	133	14.7 [5.9 - 28]	26.7 [33.7 - 8.2]	1	(D)	(D)	(D)
2016-17	SUMMER	Kentucky	58	55	1	2	2,081	38.1 [32.4 - 44]	20.8 [13.1 - 28.5]	94.8	29.3	55	610	43.1 [34.4 - 52.2]	20.8 [30.5 - 4.1]	3	(D)	(D)	(D)
2016-17	SUMMER	Louisiana	19	15	2	2	3,055	6.7 [2.7 - 13.4]	22.3 [12 - 32.6]	89.5	11.2	17	343	29.7 [20.9 - 39.6]	24 [23.6 - 5.7]	2	(D)	(D)	(D)
2016-17	SUMMER	Maine	65	59	3	3	23,635	10.2 [6.8 - 14.6]	12 [7.8 - 16.2]	93.8	1.4	61	340	9.7 [6.8 - 13.2]	11.6 [16.8 - 2.2]	4	(D)	(D)	(D)
2016-17	SUMMER	Maryland	129	123	3	3	4,480	23.4 [21.2 - 25.7]	14.8 [11 - 18.5]	90.7	32.6	117	1,461	26.9 [23.7 - 30.3]	14.1 [21.9 - 2]	12	3,019	21.6 [16.7 - 27.1]	21 [21.6 - 6.2]
2016-17	SUMMER	Massachusetts	90	89	0	1	13,634	0.5 [0 - 2.2]	15.8 [10.7 - 20.9]	94.4	2.4	85	323	16.9 [12.5 - 22.1]	15.6 [24.5 - 2.7]	5	13,311	#VALUE!	20.3 [27.8 - 12.5]
2016-17	SUMMER	Michigan	145	134	8	3	9,117	17.2 [15.9 - 18.7]	14.2 [10.4 - 17.9]	95.9	12.5	139	1,140	13.7 [11.2 - 16.6]	13.8 [22.9 - 1.9]	6	7,977	17.8 [12.8 - 23.7]	22.4 [22.6 - 9.2]
2016-17	SUMMER	Minnesota	81	70	4	7	15,625	41.8 [34.8 - 49]	20.3 [14.4 - 26.1]	87.7	6.9	71	1,074	19 [15.2 - 23.2]	19.5 [27.5 - 3.3]	10	14,551	44.3 [24.4 - 65.6]	26 [23.2 - 7.3]
2016-17	SUMMER	Mississippi	10	5	1	4	14,550	24.1 [19.3 - 29.4]	35.2 [19.4 - 51]	30.0	0.2	3	(D)	(D)	(D)	7	14,522	24.1 [18.4 - 30.4]	30.6 [20.3 - 7.7]
2016-17	SUMMER	Missouri	99	96	3	0	780	15.4 [11.2 - 20.3]	24.3 [18.5 - 30.1]	97.0	93.8	96	732	16.6 [12.2 - 21.7]	24.7 [29.8 - 3]	3	(D)	(D)	(D)
2016-17	SUMMER	Montana	21	13	2	6	26,403	11.3 [7.6 - 15.9]	13.3 [7.1 - 19.5]	52.4	0.2	11	65	16.8 [8.5 - 28.2]	15.8 [17.3 - 5.2]	10	26,338	11.3 [6.1 - 18.5]	10.5 [11.1 - 3.5]
2016-17	SUMMER	Nebraska	17	17	0	0	506	72.2 [55.9 - 85.3]	28.1 [13.5 - 42.7]	88.2	29.8	15	151	28.6 [18.5 - 40.4]	20.5 [23.4 - 6]	2	(D)	(D)	(D)
2016-17	SUMMER	Nevada	13	12	0	1	1,476	20.1 [17.8 - 22.6]	24.8 [12.9 - 36.6]	92.3	5.1	12	76	22.7 [13.1 - 34.8]	25.2 [22.7 - 6.6]	1	(D)	(D)	(D)
2016-17	SUMMER	New Hampshire	49	48	1	0	385	10.5 [7.3 - 14.4]	10.5 [5.3 - 15.7]	93.9	49.9	46	192	13 [8.7 - 18.3]	9.6 [17.1 - 2.5]	3	(D)	(D)	(D)
2016-17	SUMMER	New Jersey	75	72	2	1	2,972	29.3 [26.8 - 31.9]	12.4 [8.4 - 16.4]	93.3	15.2	70	453	19.1 [14.3 - 24.6]	12.4 [18.1 - 2.2]	5	2,519	31.8 [28.6 - 35.2]	12.3 [12.4 - 5.5]
2016-17	SUMMER	New Mexico	20	18	2	0	286	3.6 [0.5 - 11.7]	13.8 [2.1 - 25.4]	95.0	30.1	19	86	9.7 [3.5 - 20.1]	14.5 [27.1 - 6.2]	1	(D)	(D)	(D)
2016-17	SUMMER	New York	149	133	8	8	17,969	28.1 [25.8 - 30.4]	14.1 [10.5 - 17.6]	92.6	14.2	138	2,559	24.9 [22.1 - 27.9]	12.5 [21.1 - 1.8]	11	15,410	28.6 [21 - 37.3]	33.7 [24.5 - 7.4]
2016-17	SUMMER	North Carolina	221	215	4	2	5,891	18.8 [16.7 - 21.1]	17.2 [14.1 - 20.4]	95.9	22.7	212	1,337	16.2 [13.6 - 18.9]	17.2 [24.1 - 1.7]	9	4,554	19.8 [10.5 - 32]	18.4 [19.3 - 6.4]
2016-17	SUMMER	North Dakota	18	3	0	15	106,236	23.1 [14.5 - 33.5]	24.9 [12.6 - 37.2]	11.1	0.0	2	(D)	(D)	(D)	16	106,230	23.1 [14.1 - 34.2]	28 [26.6 - 6.7]
2016-17	SUMMER	Ohio	242	238	4	0	1,617	15.6 [13.1 - 18.4]	15.4 [12.5 - 18.3]	97.5	86.2	236	1,394	13.6 [11.3 - 16.2]	15.1 [22.8 - 1.5]	6	223	33.7 [15 - 56.9]	26.6 [26.8 - 11]
2016-17	SUMMER	Oklahoma	31	29	0	2	3,508	77.1 [68.9 - 84.1]	18.6 [10.8 - 26.4]	96.8	19.4	30	679	16.2 [12.6 - 20.2]	16.5 [18.8 - 3.4]	1	(D)	(D)	(D)
2016-17	SUMMER	Oregon	143	135	3	5	25,294	17.8 [16.2 - 19.6]	16.2 [11.9 - 20.5]	93.7	2.4	134	616	16.2 [12.6 - 20.3]	16.4 [26.9 - 2.3]	9	24,678	17.9 [12 - 25.1]	13.1 [13.7 - 4.6]
2016-17	SUMMER	Pennsylvania	595	574	18	3	8,171	23.7 [22 - 25.5]	13.5 [11.7 - 15.3]	97.6	40.6	581	3,318	12.5 [11 - 14]	13.3 [22.3 - 0.9]	14	4,853	32.3 [22.4 - 43.5]	19.9 [18.7 - 5]
2016-17	SUMMER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2016-17	SUMMER	Rhode Island	15	15	0	0	49	11.8 [5.9 - 20.2]	13.2 [4.5 - 21.9]	80.0	57.1	12	28	13 [5.4 - 24.7]	13.6 [18.6 - 5.4]	3	(D)	(D)	(D)
2016-17	SUMMER	South Carolina	61	58	1	2	2,283	46.5 [42.8 - 50.2]	20.1 [13.4 - 26.8]	95.1	16.5	58	376	15.9 [11.5 - 21.1]	19.5 [26.7 - 3.5]	3	(D)	(D)	(D)
2016-17	SUMMER	South Dakota	12	7	1	4	19,684	12.2 [6.6 - 19.9]	16.8 [3.6 - 30]	50.0	0.4	6	81	6.3 [0.9 - 19.1]	8.2 [16 - 6.5]	6	19,603	12.3 [4.7 - 24.3]	25.4 [27.7 - 11.3]
2016-17	SUMMER	Tennessee	60	56	4	0	766	30.2 [23.5 - 37.5]	15.6 [10.1 - 21]	100.0	100.0	60	766	30.2 [23.5 - 37.5]	15.6 [21.5 - 2.8]	0			
2016-17	SUMMER	Texas	146	131	5	10	43,955	24.2 [22.4 - 26.1]	13.7 [10.4 - 17]	92.5	8.9	135	3,912	14.6 [12.6 - 16.8]	12.6 [19.9 - 1.7]	11	40,043	25.4 [19.3 - 32.2]	26.8 [20.7 - 6.2]
2016-17	SUMMER	Utah	184	181	2	1	1,718	18.8 [15.7 - 22.3]	23.6 [18.9 - 28.2]	97.3	37.6	179	646	22.3 [18.9 - 26.1]	23 [32.3 - 2.4]	5	1,072	17.2 [3.3 - 43.3]	42 [31.7 - 14.2]
2016-17	SUMMER	Vermont	44	39	4	1	1,170	17.6 [13 - 23]	18.3 [10.2 - 26.4]	93.2	83.4	41	976	20 [15.1 - 25.6]	17.1 [26.3 - 4.1]	3	(D)	(D)	(D)
2016-17	SUMMER	Virginia	399	393	6	0	1,953	17.6 [15.2 - 20.2]	17.9 [15.2 - 20.6]	97.2	95.0	388	1,856	18.4 [15.9 - 21.1]	18.1 [27.9 - 1.4]	11	97	7 [1.9 - 16.7]	12.7 [20.6 - 6.2]
2016-17	SUMMER	Washington	91	81	4	6	49,499	16.7 [15 - 18.5]	16.5 [11.4 - 21.5]	90.1	1.1	82	522	14.4 [10 - 19.6]	16 [25.5 - 2.8]	9	48,977	16.7 [11.5 - 23]	20.8 [13.2 - 4.4]
2016-17	SUMMER	West Virginia	53	49	4	0	630	14 [9.2 - 19.9]	15.4 [9.5 - 21.4]	94.3	79.8	50	503	14.9 [9.6 - 21.4]	15.9 [22.8 - 3.2]	3	(D)	(D)	(D)
2016-17	SUMMER	Wisconsin	102	92	8	2	13,524	18.2 [16.6 - 19.9]	18.3 [13.9 - 22.8]	94.1	10.2	96	1,377	22.4 [19.4 - 25.6]	18.2 [23.5 - 2.4]	6	12,147	17.5 [12.6 - 23.3]	20.7 [12.6 - 5.1]
2016-17	SUMMER	Wyoming	19	16	1	2	4,976	8.4 [4.3 - 14.1]	20.7 [9 - 32.3]	78.9	1.5	15	74	48.7 [29.9 - 67.8]	22.8 [28.2 - 7.3]	4	(D)	(D)	(D)
2016-17	SUMMER	Other	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2016-17	SUMMER	MultiStateOperation	131	56	21	54	219,735	18.5 [15.6 - 21.7]	21.7 [17.9 - 25.5]	0.0	0.0	131	219,735	18.5 [15.6 - 21.7]	21.7 [22.4 - 2]	131	219,735	18.5 [15.6 - 21.7]	21.7 [22.4 - 2]
2007-08	WINTER	Alabama	16	9	4	3	4,848	41.9 [31.6 - 52.8]	29.6 [19.7 - 39.5]	100.0	100.0	16	4,848	41.9 [31.6 - 52.8]	29.6 [20.1 - 5]	0			
2007-08	WINTER	Alaska	0																
2007-08	WINTER	Arizona	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Arkansas	20	10	5	5	16,955	17.4 [13 - 22.6]	12.8 [7 - 18.6]	100.0	100.0	20	16,955	17.4 [13 - 22.6]	12.8 [13.2 - 2.9]	0			
2007-08	WINTER	California	36	0	0	36	184,085	29.3 [22.8 - 36.3]	29.3 [22 - 36.7]	13.9	9.2	5	16,865	51.3 [38.7 - 63.8]	37.8 [19 - 8.5]	31	167,220	26.9 [20.3 - 34.4]	28 [22.9 - 4.1]
2007-08	WINTER	Colorado	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Connecticut	0																
2007-08	WINTER	District of Columbia	0																
2007-08	WINTER	Delaware	0																
2007-08	WINTER	Florida	23	4	6	13	50,897	40 [29 - 51.8]	30 [19 - 41]	65.2	33.6	15	17,092	29.3 [17.3 - 43.7]	27.5 [27.9 - 7.2]	8	33,805	45.9 [27 - 65.6]	34.8 [26 - 9.2]
2007-08	WINTER	Georgia	15	0	3	12	42,876	34.5 [26.8 - 42.7]	29.1 [18.9 - 39.2]	100.0	100.0	15	42,876	34.5 [26.8 - 42.7]	29.1 [20 - 5.2]	0			
2007-08	WINTER	Hawaii	0																
2007-08	WINTER	Idaho	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Illinois	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Indiana	0																
2007-08	WINTER	Iowa	12	10	1	1	723	40.2 [32.5 - 48.3]	44.9 [28.6 - 61.3]	100.0	100.0	12	723	40.2 [32.5 - 48.3]	44.9 [28.9 - 8.3]	0			
2007-08	WINTER	Kansas	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Kentucky	0																
2007-08	WINTER	Louisiana	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Maine	6	1	0	5	45,937	18 [9.1 - 30]	14.1 [4.5 - 23.8]	16.7	0.1	1	(D)	(D)	(D)	5	45,900	18 [8.3 - 31.6]	15.9 [12.7 - 5.7]
2007-08	WINTER	Maryland	14	6	5	3	4,013	7.6 [4.1 - 12.4]	14.7 [8.2 - 21.3]	100.0	100.0	14	4,013	7.6 [4.1 - 12.4]	14.7 [12.4 - 3.3]	0			
2007-08	WINTER	Massachusetts	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Michigan	15	8	4	3	6,607	56.2 [41.1 - 70.7]	51.1 [34.2 - 68]	93.3	94.7	14	6,257	60.1 [45.4 - 73.7]	54.1 [32.5 - 8.7]	1	(D)	(D)	(D)
2007-08	WINTER	Minnesota	0																
2007-08	WINTER	Mississippi	14	4	6	4	9,145	26.7 [18.9 - 35.7]	31 [19.7 - 42.3]	100.0	100.0	14	9,145	26.7 [18.9 - 35.7]	31 [21.5 - 5.7]	0			
2007-08	WINTER	Missouri	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Montana	13	3	1	9	55,330	27.7 [19.6 - 36.9]	34.2 [19.4 - 49]	30.8	0.8	4	(D)	(D)	(D)	9	54,900	27.8 [18 - 39.2]	26.8 [23.6 - 7.9]
2007-08	WINTER	Nebraska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Nevada	0																
2007-08	WINTER	New Hampshire	0																
2007-08	WINTER	New Jersey	15	5	6	4	22,622	15.1 [7.9 - 24.9]	18.2 [10.1 - 26.3]	80.0	12.0	12	2,722	27.5 [19.3 - 37]	17.9 [15.6 - 4.5]	3	(D)	(D)	(D)
2007-08	WINTER	New Mexico	7	1	5	1	4,850	20.5 [15.2 - 26.7]	24.6 [7.5 - 41.8]	57.1	79.9	4	(D)	(D)	(D)	3	(D)	(D)	(D)
2007-08	WINTER	New York	12	3	1	8	26,950	18.8 [8.8 - 32.7]	24.5 [13.1 - 35.9]	75.0	33.6	9	9,050	39.7 [26.7 - 53.7]	29.8 [20.7 - 6.9]	3	(D)	(D)	(D)
2007-08	WINTER	North Carolina	16	5	7	4	6,532	27.5 [18.3 - 38.2]	28 [19.9 - 36]	100.0	100.0	16	6,532	27.5 [18.3 - 38.2]	28 [16.4 - 4.1]	0			
2007-08	WINTER	North Dakota	18	2	0	16	103,447	25.6 [19.1 - 32.8]	31.4 [19.9 - 42.9]	16.7	1.1	3	(D)	(D)	(D)	15	102,300	25.4 [18.4 - 33.4]	24.2 [16.4 - 4.2]
2007-08	WINTER	Ohio	9	6	1	2	1,365	42.4 [30.2 - 55.3]	33.9 [20.8 - 46.9]	100.0	100.0	9	1,365	42.4 [30.2 - 55.3]	33.9 [20 - 6.7]	0			
2007-08	WINTER	Oklahoma	0																
2007-08	WINTER	Oregon	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Pennsylvania	192	167	19	6	15,974	26.2 [23.4 - 29.2]	16.5 [13.5 - 19.6]	98.4	48.3	189	7,719	21.5 [18.7 - 24.5]	16.3 [21.6 - 1.6]	3	(D)	(D)	(D)
2007-08	WINTER	Puerto Rico	0																
2007-08	WINTER	Rhode Island	0																
2007-08	WINTER	South Carolina	5	0	2	3	5,590	34.3 [20 - 50.9]	37.8 [23.4 - 52.1]	80.0	64.2	4	(D)	(D)	(D)	1	(D)	(D)	(D)
2007-08	WINTER	South Dakota	18	3	3	12	99,011	52 [44.9 - 59]	41.4 [30.6 - 52.2]	83.3	81.6	15	80,811	48.9 [44.6 - 53.3]	37.7 [20.8 - 5.4]	3	(D)	(D)	(D)
2007-08	WINTER	Tennessee	8	5	3	0	516	26.6 [9.9 - 49.6]	22.4 [2.2 - 42.6]	100.0	100.0	8	516	26.6 [9.9 - 49.6]	22.4 [29.1 - 10.3]	0			
2007-08	WINTER	Texas	9	0	0	9	52,800	32.3 [21.4 - 44.7]	40.7 [26.6 - 54.9]	0.0	0.0	0				9	52,800	32.3 [21.4 - 44.7]	40.7 [21.7 - 7.2]
2007-08	WINTER	Utah	28	13	4	11	17,709	24.8 [17.2 - 33.6]	42.2 [31.1 - 53.2]	100.0	100.0	28	17,709	24.8 [17.2 - 33.6]	42.2 [29.8 - 5.6]	0			
2007-08	WINTER	Vermont	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Virginia	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2007-08	WINTER	Washington	5	0	0	5	21,870	13.7 [8.9 - 19.6]	10.7 [6 - 15.4]	0.0	0.0	0				5	21,870	13.7 [8.9 - 19.6]	10.7 [5.4 - 2.4]
2007-08	WINTER	West Virginia	17	10	4	3	3,399	51.6 [38.3 - 64.7]	30.3 [13.8 - 46.8]	94.1	64.0	16	2,174	35.1 [24.7 - 46.6]	27.3 [33.4 - 8.4]	1	(D)	(D)	(D)
2007-08	WINTER	Wisconsin	15	6	5	4	6,122	33.8 [18.8 - 51.5]	48.5 [35.1 - 61.9]	93.3	56.7	14	3,472	66.2 [60.1 - 72]	51.7 [24.3 - 6.5]	1	(D)	(D)	(D)
2007-08	WINTER	Wyoming	0																
2007-08	WINTER	Other	0																
2007-08	WINTER	MultiStateOperation	43	0	3	40	202,865	31.2 [24.5 - 38.4]	29.8 [22.6 - 36.9]	0.0	0.0	43	202,865	31.2 [24.5 - 38.4]	29.8 [23.9 - 3.6]	43	202,865	31.2 [24.5 - 38.4]	29.8 [23.9 - 3.6]
2008-09	WINTER	Alabama	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Alaska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Arizona	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Arkansas	28	15	7	6	7,394	22.2 [19.9 - 24.7]	28.3 [20.1 - 36.6]	100.0	100.0	28	7,394	22.2 [19.9 - 24.7]	28.3 [22.2 - 4.2]	0			

			All operations in the State										Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2008-09	WINTER	California	60	14	6	40	266,566	25.7 [22.7 - 28.8]	32.8 [26.6 - 38.9]	30.0	2.3	18	6,050	31.1 [28.5 - 33.8]	40.6 [30.1 - 7.1]	42	260,516	25.6 [22 - 29.3]	29.4 [21 - 3.2]
2008-09	WINTER	Colorado	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Connecticut	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	District of Columbia	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Delaware	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Florida	20	9	2	9	28,304	26.9 [22.2 - 32]	19.1 [10.9 - 27.2]	55.0	29.1	11	8,236	28.2 [25.9 - 30.7]	16.5 [22 - 6.6]	9	20,068	26.2 [17.8 - 35.9]	22.3 [14 - 4.7]
2008-09	WINTER	Georgia	44	29	11	4	7,269	18.3 [15 - 21.9]	25.1 [16.2 - 34]	95.5	87.1	42	6,334	19.7 [16.4 - 23.4]	26 [30.6 - 4.7]	2	(D)	(D)	(D)
2008-09	WINTER	Hawaii	0																
2008-09	WINTER	Idaho	14	1	3	10	43,449	33.1 [23.2 - 44.2]	24.2 [14.6 - 33.8]	92.9	87.8	13	38,149	26.7 [19.7 - 34.7]	20.7 [13.4 - 3.7]	1	(D)	(D)	(D)
2008-09	WINTER	Illinois	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Indiana	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Iowa	17	11	2	4	11,703	51.4 [45.8 - 57.1]	63.4 [52.7 - 74.1]	100.0	100.0	17	11,703	51.4 [45.8 - 57.1]	63.4 [22.5 - 5.5]	0			
2008-09	WINTER	Kansas	0																
2008-09	WINTER	Kentucky	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Louisiana	10	2	3	5	60,835	41.8 [31.6 - 52.5]	37.5 [25.2 - 49.9]	70.0	48.9	7	29,750	49.9 [41.3 - 58.6]	41.1 [19.9 - 7.5]	3	(D)	(D)	(D)
2008-09	WINTER	Maine	38	34	1	3	44,971	21.7 [20.9 - 22.6]	33 [21 - 45]	92.1	0.4	35	171	35 [26.5 - 44.2]	33.8 [39.3 - 6.6]	3	(D)	(D)	(D)
2008-09	WINTER	Maryland	15	8	4	3	5,931	13.5 [8.2 - 20.5]	21 [12.2 - 29.8]	100.0	100.0	15	5,931	13.5 [8.2 - 20.5]	21 [17.3 - 4.5]	0			
2008-09	WINTER	Massachusetts	38	37	0	1	20,174	20.2 [19.1 - 21.4]	44 [31.5 - 56.4]	97.4	0.9	37	174	50.8 [41 - 60.5]	44.6 [39.5 - 6.5]	1	(D)	(D)	(D)
2008-09	WINTER	Michigan	21	13	3	5	8,722	17.9 [12.5 - 24.3]	42.5 [28.5 - 56.5]	90.5	62.2	19	5,422	11.5 [5.6 - 20.1]	44.3 [34.1 - 7.8]	2	(D)	(D)	(D)
2008-09	WINTER	Minnesota	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Mississippi	15	7	4	4	18,352	48.2 [41.7 - 54.7]	37.9 [28.7 - 47.1]	73.3	7.2	11	1,327	24.4 [16.2 - 34]	38 [18.1 - 5.5]	4	(D)	(D)	(D)
2008-09	WINTER	Missouri	0																
2008-09	WINTER	Montana	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Nebraska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Nevada	0																
2008-09	WINTER	New Hampshire	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	New Jersey	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	New Mexico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	New York	28	13	6	9	35,182	24.1 [18.8 - 30.1]	29 [20.1 - 37.9]	89.3	36.6	25	12,882	32.4 [23.8 - 41.9]	30.5 [25 - 5]	3	(D)	(D)	(D)
2008-09	WINTER	North Carolina	51	37	12	2	7,635	39.4 [34.1 - 45]	33.2 [24.9 - 41.5]	100.0	100.0	51	7,635	39.4 [34.1 - 45]	33.2 [30.2 - 4.2]	0			
2008-09	WINTER	North Dakota	24	3	3	18	209,297	25.3 [21.5 - 29.3]	31.8 [22.2 - 41.4]	12.5	0.0	3	(D)	(D)	(D)	21	209,283	25.3 [21.2 - 29.6]	26.3 [18.2 - 4]
2008-09	WINTER	Ohio	9	9	0	0	51	44.6 [30.6 - 59.3]	53.7 [26.6 - 80.8]	100.0	100.0	9	51	44.6 [30.6 - 59.3]	53.7 [41.5 - 13.8]	0			
2008-09	WINTER	Oklahoma	0																
2008-09	WINTER	Oregon	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Pennsylvania	262	232	26	4	11,744	40.6 [37.6 - 43.5]	33.9 [30.2 - 37.5]	98.1	55.0	257	6,459	35.1 [32 - 38.2]	34 [30.3 - 1.9]	5	5,285	45.9 [26.2 - 66.6]	29 [30.6 - 13.7]
2008-09	WINTER	Puerto Rico	0																
2008-09	WINTER	Rhode Island	5	5	0	0	30	40.6 [13.3 - 73]	59.8 [18.5 - 101.1]	100.0	100.0	5	30	40.6 [13.3 - 73]	59.8 [47.1 - 21.1]	0			
2008-09	WINTER	South Carolina	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	South Dakota	27	5	5	17	162,597	27 [22.3 - 32.1]	25.1 [17.3 - 32.9]	22.2	1.1	6	1,854	33.4 [29.8 - 37.1]	11.4 [16.1 - 6.6]	21	160,743	27 [21.6 - 32.8]	29 [20.5 - 4.5]
2008-09	WINTER	Tennessee	7	7	0	0	42	8.1 [1.3 - 23.1]	6.5 [-3.6 - 16.6]	100.0	100.0	7	42	8.1 [1.3 - 23.1]	6.5 [13.6 - 5.1]	0			
2008-09	WINTER	Texas	11	1	0	10	49,401	29.3 [24 - 35]	23.9 [16.3 - 31.5]	9.1	0.0	1	(D)	(D)	(D)	10	49,400	29.3 [23.7 - 35.3]	26.3 [10.7 - 3.4]
2008-09	WINTER	Utah	27	15	4	8	18,921	36.4 [26.8 - 46.7]	25.1 [15.9 - 34.3]	96.3	72.0	26	13,621	18.3 [14 - 23.3]	23.4 [23.2 - 4.6]	1	(D)	(D)	(D)
2008-09	WINTER	Vermont	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Virginia	36	36	0	0	161	46.4 [36.6 - 56.4]	44.3 [32.8 - 55.7]	100.0	100.0	36	161	46.4 [36.6 - 56.4]	44.3 [35.2 - 5.9]	0			
2008-09	WINTER	Washington	8	5	0	3	43,708	20.4 [17.3 - 23.8]	30.1 [6.8 - 53.3]	62.5	0.1	5	54	18.5 [4 - 44.4]	36.2 [42.7 - 19.1]	3	(D)	(D)	(D)
2008-09	WINTER	West Virginia	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2008-09	WINTER	Wisconsin	17	8	6	3	3,871	44.7 [39.1 - 50.4]	39.3 [26.2 - 52.4]	100.0	100.0	17	3,871	44.7 [39.1 - 50.4]	39.3 [27.5 - 6.7]	0			
2008-09	WINTER	Wyoming	0																
2008-09	WINTER	Other	0																
2008-09	WINTER	MultiStateOperation	52	1	8	43	287,476	27 [23.5 - 30.8]	28.3 [22.7 - 33.9]	0.0	0.0	52	287,476	27 [23.5 - 30.8]	28.3 [20.7 - 2.9]	52	287,476	27 [23.5 - 30.8]	28.3 [20.7 - 2.9]
2009-10	WINTER	Alabama	46	39	7	0	1,357	28.9 [23.6 - 34.7]	35.7 [25.9 - 45.4]	95.7	95.3	44	1,293	27.8 [22.5 - 33.6]	33.9 [33 - 5]	2	(D)	(D)	(D)
2009-10	WINTER	Alaska	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2009-10	WINTER	Arizona	5	2	2	1	2,136	12.8 [2.9 - 31.5]	32.7 [0 - 65.5]	40.0	7.1	2	(D)	(D)	(D)	3	(D)	(D)	(D)
2009-10	WINTER	Arkansas	50	49	1	0	447	23.5 [17.4 - 30.3]	26.8 [18.4 - 35.2]	96.0	98.4	48	440	23.2 [17.1 - 30.1]	25.4 [29 - 4.2]	2	(D)	(D)	(D)
2009-10	WINTER	California	166	87	17	62	333,778	31.7 [28.9 - 34.6]	39.4 [34.7 - 44]	62.7	6.4	104	21,510	38.6 [35.3 - 42.1]	43 [33.8 - 3.3]	62	312,268	31.3 [26.7 - 36.2]	33.2 [22.8 - 2.9]
2009-10	WINTER	Colorado	99	93	5	1	6,627	33 [30.3 - 35.8]	42.5 [35.3 - 49.6]	94.9	14.0	94	927	36.2 [31 - 41.6]	42.6 [37 - 3.8]	5	5,700	32.6 [22.5 - 43.9]	39.6 [20.2 - 9.1]
2009-10	WINTER	Connecticut	58	55	3	0	742	50.5 [43.4 - 57.6]	50.6 [40.5 - 60.8]	87.9	38.1	51	283	46.5 [38.2 - 54.9]	50.1 [39.8 - 5.6]	7	459	53.1 [33.5 - 72.1]	54.5 [39.5 - 14.9]
2009-10	WINTER	District of Columbia	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2009-10	WINTER	Delaware	15	15	0	0	95	54.8 [35.5 - 73.1]	54.8 [34.6 - 75.1]	93.3	92.6	14	88	53.6 [33.3 - 73.2]	53.7 [41.2 - 11]	1	(D)	(D)	(D)
2009-10	WINTER	Florida	153	130	12	11	32,900	53.4 [49.9 - 56.9]	28.9 [24.1 - 33.8]	89.5	12.2	137	4,025	45.2 [42 - 48.4]	27.3 [29.8 - 2.5]	16	28,875	54.2 [43 - 65.1]	43.2 [32.3 - 8.1]
2009-10	WINTER	Georgia	87	78	3	6	7,165	47.7 [43.3 - 52.1]	43.2 [36.1 - 50.3]	92.0	8.9	80	638	38.3 [32.6 - 44.2]	42.3 [34.1 - 3.8]	7	6,527	48.6 [33 - 64.3]	53.3 [31 - 11.7]
2009-10	WINTER	Hawaii	8	8	0	0	51	21.4 [11.6 - 34.2]	11.5 [0.4 - 22.6]	87.5	92.2	7	47	23.1 [12.8 - 36.2]	13.1 [16.6 - 6.3]	1	(D)	(D)	(D)
2009-10	WINTER	Idaho	27	24	1	2	23,211	27.3 [23.1 - 31.8]	43.8 [30.8 - 56.7]	92.6	0.9	25	211	27.6 [17.7 - 39.2]	45.8 [34.7 - 6.9]	2	(D)	(D)	(D)
2009-10	WINTER	Illinois	49	45	4	0	958	73 [66.4 - 79.1]	48.3 [37.9 - 58.7]	87.8	27.1	43	260	49.6 [41 - 58.3]	44.1 [37.6 - 5.7]	6	698	82.1 [73.1 - 89.2]	78 [12.4 - 5]
2009-10	WINTER	Indiana	85	81	3	1	4,141	57.1 [54.3 - 59.9]	47.5 [39.8 - 55.2]	95.3	18.3	81	757	57.8 [51.5 - 64.1]	48 [36.4 - 4]	4	(D)	(D)	(D)
2009-10	WINTER	Iowa	56	52	4	0	1,141	73.4 [67.7 - 78.5]	57.1 [48.1 - 66.1]	94.6	55.7	53	636	68.3 [62.2 - 74]	57.7 [34.2 - 4.7]	3	(D)	(D)	(D)
2009-10	WINTER	Kansas	10	7	1	2	5,251	39.2 [33.1 - 45.6]	41 [22.6 - 59.3]	70.0	1.4	7	76	46.2 [30.7 - 62.2]	40 [35.6 - 13.5]	3	(D)	(D)	(D)
2009-10	WINTER	Kentucky	25	22	3	0	613	48.9 [34.3 - 63.6]	38.1 [24.8 - 51.3]	88.0	61.3	22	376	67.2 [54.3 - 78.6]	39.2 [33.4 - 7.1]	3	(D)	(D)	(D)
2009-10	WINTER	Louisiana	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2009-10	WINTER	Maine	89	84	1	4	13,945	57 [52.5 - 61.4]	22.9 [15.8 - 30]	92.1	3.4	82	476	24.5 [18.5 - 31.2]	20.7 [33.5 - 3.7]	7	13,469	57.5 [40.8 - 73.2]	47.9 [35.1 - 13.3]
2009-10	WINTER	Maryland	171	164	6	1	4,145	38.7 [35.6 - 41.8]	36.3 [30.7 - 41.9]	94.2	80.8	161	3,348	37.7 [35 - 40.5]	36.4 [38 - 3]	10	797	43 [25 - 62.5]	34.5 [28.8 - 9.1]
2009-10	WINTER	Massachusetts	193	188	1	4	11,361	63.2 [61.1 - 65.4]	46.1 [40.5 - 51.8]	96.9	12.6	187	1,429	30.7 [26.5 - 35.1]	46.3 [40.4 - 3]	6	9,932	65.4 [55.7 - 74.2]	41.6 [30.4 - 12.4]
2009-10	WINTER	Michigan	231	209	17	5	11,776	44.9 [41.2 - 48.6]	49.9 [45.2 - 54.6]	96.5	34.2	223	4,032	52.9 [49.1 - 56.8]	49.9 [36.4 - 2.4]	8	7,744	41.1 [22.7 - 61.4]	48.8 [32.4 - 11.5]
2009-10	WINTER	Minnesota	37	28	2	7	101,437	31.8 [29.1 - 34.5]	50 [38.9 - 61.1]	75.7	0.9	28	916	41.2 [31.2 - 51.7]	51.9 [36.4 - 6.9]	9	100,521	31.7 [26.4 - 37.4]	44.3 [28.6 - 9.5]
2009-10	WINTER	Mississippi	14	10	2	2	11,196	45.8 [35.4 - 56.5]	38.4 [22.9 - 53.8]	85.7	3.3	12	372	41 [30.4 - 52.3]	35.5 [29.6 - 8.5]	2	(D)	(D)	(D)
2009-10	WINTER	Missouri	42	38	4	0	1,045	28.9 [22.9 - 35.5]	36.4 [26.3 - 46.6]	95.2	73.2	40	765	23.5 [17.2 - 30.8]	36.7 [34.4 - 5.4]	2	(D)	(D)	(D)
2009-10	WINTER	Montana	24	9	2	13	105,509	29.5 [20.7 - 39.4]	28.8 [19.1 - 38.4]	37.5	0.1	9	126	13.5 [6.9 - 22.7]	29.5 [32.5 - 10.8]	15	105,383	29.5 [18.6 - 42.4]	28.3 [19 - 4.9]
2009-10	WINTER	Nebraska	17	13	0	4	85,286	28.5 [24 - 33.4]	57.9 [40.9 - 74.9]	70.6	0.1	12	82	58.5 [42.9 - 73.1]	66.9 [37.2 - 10.7]	5	85,204	28.5 [19.8 - 38.5]	36.3 [22.6 - 10.1]
2009-10	WINTER	Nevada	5	3	1	1	1,851	11.2 [1.3 - 35.2]	44.4 [19.5 - 69.3]	60.0	1.1	3	(D)	(D)	(D)	2	(D)	(D)	(D)
2009-10	WINTER	New Hampshire	76	73	3	0	802	26.2 [20.1 - 33]	37.2 [28.5 - 45.9]	93.4	80.8	71	648	19.2 [13.7 - 25.6]	36.2 [38.8 - 4.6]	5	154	53.9 [32.3 - 74.6]	50.8 [39.5 - 17.7]
2009-10	WINTER	New Jersey	31	28	1	2	3,046	10.4 [5.8 - 16.6]	34 [20.6 - 47.3]	77.4	4.0	24	123	39.8 [28.4 - 52]	36.2 [40.5 - 8.3]	7	2,923	9.4 [2.2 - 23.3]	26.2 [28.9 - 10.9]
2009-10	WINTER	New Mexico	9	8	0	1	3,034	37.9 [34.4 - 41.4]	58.2 [34.3 - 82.2]	100.0	100.0	9	3,034	37.9 [34.4 - 41.4]	58.2 [36.7 - 12.2]	0			
2009-10	WINTER	New York	162	126	21	15	22,154	38.8 [35.7 - 42]	43.3 [38.4 - 48.2]	85.8	31.3	139	6,927	31.9 [29 - 34.9]	42.7 [32.7 - 2.8]	23	15,227	41.2 [32.7 - 50]	47.2 [24.8 - 5.2]
2009-10	WINTER	North Carolina	191	186	3	2	3,126	45.6 [41.3 - 50.1]	36 [31.1 - 40.8]	95.8	77.6	183	2,427	53.5 [49.2 - 57.8]	36.4 [34 - 2.5]	8	699	16.3 [9.6 - 25]	26.1 [33.5 - 11.9]
2009-10	WINTER	North Dakota	30	2	6	22	213,327	26.6 [21.7 - 31.9]	31.6 [22.6 - 40.6]	26.7	3.9	8	8,328	14.1 [3.9 - 31.8]	30.4 [26.2 - 9.2]	22	204,999	27.1 [21.6 - 33.1]	32 [25.4 - 5.4]
2009-10	WINTER	Ohio	203	197	5	1	4,828	52.4 [50 - 54.9]	44 [39 - 48.9]	97.0	34.8	197	1,681	48 [43.9 - 52.1]	44.4 [36.2 - 2.6]	6	3,147	54.7 [49.3 - 60]	31.8 [21.3 - 8.7]
2009-10	WINTER	Oklahoma	10	9	1	0	139	39 [29.3 - 49.3]	32.9 [20.8 - 44.9]	90.0	96.4	9	134	39.7 [29.5 - 50.5]	34.3 [20.1 - 6.7]	1	(D)	(D)	(D)
2009-10	WINTER	Oregon	49	41	3	5	27,497	29.7 [23.4 - 36.5]	53.2 [43.1 - 63.2]	89.8	3.9	44	1,060	61.9 [55.6 - 67.8]	56.2 [36.1 - 5.4]	5	26,437	28.5 [10.8 - 52.6]	26.3 [21.9 - 9.8]
2009-10	WINTER	Pennsylvania	546	521	24	1	8,843	42.6 [40.7 - 44.5]	46.8 [43.8 - 49.9]	96.9	57.7	529	5,101	45.2 [42.9 - 47.5]	46.9 [36.7 - 1.6]	17	3,742	40 [32 - 48.3]	43.7 [36.2 - 8.8]
2009-10	WINTER	Puerto Rico	0																
2009-10	WINTER	Rhode Island	67	67	0	0	262	37.3 [29.7 - 45.3]	41.4 [32.1 - 50.7]	92.5	93.5	62	245	35.3 [27.7 - 43.3]	41.1 [38.7 - 4.9]	5	17	61.9 [24.6 - 91]	45 [44.7 - 20]
2009-10	WINTER	South Carolina	126	111	8	7	9,819	34.4 [30.4 - 38.5]	37.9 [32.1 - 43.6]	88.9	14.6	112	1,434	41.5 [37.1 - 46.1]	37.5 [33.4 - 3.2]	14	8,385	33.3 [21.9 - 46.2]	40.9 [28 - 7.5]
2009-10	WINTER	South Dakota	16	2	1	13	143,276	28.1 [20.6 - 36.6]	34.3 [22 - 46.5]	12.5	0.0	2	(D)	(D)	(D)	14	143,255	28.1 [20 - 37.2]	36 [24.8 - 6.6]
2009-10	WINTER	Tennessee	62	59	3	0	661	28.9 [21.8 - 36.8]	39.6 [30.3 - 48.9]	98.4	84.4	61	558	33.7 [26.5 - 41.5]	40.2 [37.2 - 4.8]	1	(D)	(D)	(D)
2009-10	WINTER	Texas	59	44	5	10	50,739	38.6 [35 - 42.4]	32.7 [25.6 - 39.8]	83.1	8.5	49	4,301	53.4 [49.1 - 57.7]	30.6 [28.8 - 4.1]	10	46,438	37.2 [28.7 - 46.3]	42.6 [21.2 - 6.7]
2009-10	WINTER	Utah	64	57	2	5	7,768	20.8 [16.9 - 25.1]	44.6 [35.7 - 53.5]	93.8	13.2	60	1,027	32.8 [27.5 - 38.3]	46.1 [36.8 - 4.7]	4	(D)	(D)	(D)
2009-10	WINTER	Vermont	68	65	1	2	2,648	29 [24.6 - 33.7]	40 [31.8 - 48.1]	94.1	69.7	64	1,846	17.1 [13.5 - 21]	39.3 [34.4 - 4.3]	4	(D)	(D)	(D)
2009-10	WINTER	Virginia	480	476	4	0	3,181	38 [35.4 - 40.7]	37.9 [34.7 - 41.1]	97.1	94.3	466	2,999	37.9 [35.2 - 40.6]	38 [36 - 1.7]	14	182	40.1 [26.3 - 55.1]	32.7 [32.6 - 8.7]
2009-10	WINTER	Washington	144	131	3	10	69,351	32.5 [29.6 - 35.5]	40.9 [34.8 - 47.1]	92.4	1.6	133	1,136	33.1 [28.3 - 38]	42.1 [38.5 - 3.3]	11	68,215	32.5 [22.3 - 43.9]	26.5 [17.6 - 5.3]
2009-10	WINTER	West Virginia	117	111	6	0	1,390	50.1 [44.4 - 55.8]	52.6 [46.2 - 59]	91.5	61.2	107	850	51.6 [46.2 - 57]	53.1 [35.7 - 3.5]	10	540	47.7 [26 - 70]	47.3 [30.1 - 9.5]
2009-10	WINTER	Wisconsin	155	140	9	6	12,097	33.3 [28.9 - 37.8]	59.2 [53.7 - 64.7]	92.3	33.2	143	4,017	54.3 [49.8 - 58.7]	59.4 [35.2 - 2.9]	12	8,080	22.3 [11.1 - 37.1]	57.2 [30.8 - 8.9]
2009-10	WINTER	Wyoming	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2009-10	WINTER	Other	0																
2009-10	WINTER	MultiStateOperation	161	55	35	71	344,782	33.5 [30.4 - 36.7]	40.3 [35.7 - 44.8]	0.0	0.0	161	344,782	33.5 [30.4 - 36.7]	40.3 [29.4 - 2.3]	161	344,782	33.5 [30.4 - 36.7]	40.3 [29.4 - 2.3]
2010-11	WINTER	Alabama	34	33	1	0	476	11.4 [6.6 - 17.7]	15.7 [7.8 - 23.7]	97.1	97.9	33	466	10.8 [6.1 - 17.2]	15 [23.6 - 4.1]	1	(D)	(D)	(D)
2010-11	WINTER	Alaska	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	WINTER	Arizona	7	7	0	0	41	31.4 [14.6 - 52.4]	26.4 [4.6 - 48.2]	100.0	100.0	7	41	31.4 [14.6 - 52.4]	26.4 [29.4 - 11.1]	0			
2010-11	WINTER	Arkansas	43	43	0	0	297	30.2 [22.6 - 38.6]	22.4 [13.6 - 31.2]	95.3	96.0	41	285	31.1 [23.2 - 39.7]	23.2 [30 - 4.7]	2	(D)	(D)	(D)
2010-11	WINTER	California	327	253	25	49	248,736	27.2 [25 - 29.4]	39.2 [35.3 - 43.1]	82.9	12.7	271	31,625	40 [35.9 - 44.3]	42.3 [37.3 - 2.3]	56	217,111	25.1 [21.1 - 29.3]	24 [20.2 - 2.7]

SurveyYear	Season	State	All operations in the State: N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State: N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations: N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2010-11	WINTER	Colorado	137	132	4	1	1,744	53.4 [48.5 - 58.4]	32.7 [26.9 - 38.5]	97.1	53.6	133	935	28.7 [24.8 - 32.9]	32.3 [34.9 - 3]	4	(D)	(D)	(D)
2010-11	WINTER	Connecticut	102	99	3	0	884	46.6 [41.2 - 52.1]	51 [43.8 - 58.1]	95.1	56.8	97	502	56.9 [50.7 - 62.9]	51 [37.4 - 3.8]	5	382	32.5 [18.8 - 48.4]	50.9 [34.6 - 15.5]
2010-11	WINTER	District of Columbia	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	WINTER	Delaware	15	15	0	0	61	58.8 [37.9 - 77.7]	32.2 [12.5 - 51.9]	93.3	86.9	14	53	58.4 [35.9 - 78.7]	30 [39.4 - 10.5]	1	(D)	(D)	(D)
2010-11	WINTER	Florida	133	118	8	7	28,065	40.3 [36.9 - 43.8]	25.6 [20.5 - 30.7]	93.2	7.3	124	2,055	40.7 [36.7 - 44.9]	24.1 [30.1 - 2.7]	9	26,010	40.3 [27.4 - 54.2]	46.3 [20.7 - 6.9]
2010-11	WINTER	Georgia	143	131	11	1	6,006	63.9 [58.6 - 69]	28.1 [22.8 - 33.4]	93.7	22.1	134	1,329	38 [31.6 - 44.6]	27.2 [32.6 - 2.8]	9	4,677	70.2 [50.5 - 85.8]	41 [22.5 - 7.5]
2010-11	WINTER	Hawaii	42	36	5	1	5,392	7.8 [3.5 - 14.4]	44.6 [33.2 - 56.1]	100.0	100.0	42	5,392	7.8 [3.5 - 14.4]	44.6 [37.9 - 5.8]	0			
2010-11	WINTER	Idaho	27	24	1	2	9,325	5.8 [3.8 - 8.3]	30.4 [17.2 - 43.6]	81.5	1.0	22	96	26.9 [17.7 - 37.7]	34.3 [37.6 - 8]	5	9,229	5.5 [2 - 11.6]	13.4 [9.6 - 4.3]
2010-11	WINTER	Illinois	136	134	2	0	1,045	45 [39.8 - 50.3]	55 [48.5 - 61.4]	97.8	95.5	133	998	44 [38.6 - 49.4]	54.8 [38.7 - 3.4]	3	(D)	(D)	(D)
2010-11	WINTER	Indiana	152	148	4	0	1,205	46.2 [41.1 - 51.3]	42 [36 - 48]	100.0	100.0	152	1,205	46.2 [41.1 - 51.3]	42 [37.6 - 3.1]	0			
2010-11	WINTER	Iowa	28	26	2	0	729	66 [57.5 - 73.9]	45.1 [32.1 - 58]	96.4	99.7	27	727	66.1 [57.4 - 74]	44.9 [35.7 - 6.9]	1	(D)	(D)	(D)
2010-11	WINTER	Kansas	21	19	2	0	401	14.5 [9.4 - 20.7]	22.1 [9.4 - 34.8]	95.2	98.0	20	393	14.5 [9.3 - 21]	22.6 [30.4 - 6.8]	1	(D)	(D)	(D)
2010-11	WINTER	Kentucky	55	47	8	0	931	30.6 [24.4 - 37.3]	28.3 [19 - 37.7]	98.2	96.8	54	901	31.1 [24.8 - 37.9]	28.6 [35.5 - 4.8]	1	(D)	(D)	(D)
2010-11	WINTER	Louisiana	17	13	3	1	3,411	25.1 [22.3 - 28.1]	18.6 [6.5 - 30.8]	94.1	17.3	16	591	23.5 [17.3 - 30.5]	18.2 [26.3 - 6.6]	1	(D)	(D)	(D)
2010-11	WINTER	Maine	106	102	1	3	14,614	45.9 [41.8 - 50.1]	48.4 [40.8 - 55.9]	95.3	4.4	101	637	39.1 [32.8 - 45.6]	48.7 [40.3 - 4]	5	13,977	46.1 [26.4 - 66.7]	41 [31.4 - 14]
2010-11	WINTER	Maryland	172	167	5	0	1,456	49.4 [44.4 - 54.4]	37.2 [32.1 - 42.3]	97.7	94.6	168	1,378	49.9 [44.8 - 55.1]	37.1 [34.3 - 2.6]	4	(D)	(D)	(D)
2010-11	WINTER	Massachusetts	219	215	0	4	13,550	34.7 [33.2 - 36.2]	46.3 [41.3 - 51.2]	95.4	17.0	209	2,297	29 [25.2 - 33]	46.6 [38 - 2.6]	10	11,253	35.5 [32.1 - 39]	39.8 [20.3 - 6.4]
2010-11	WINTER	Michigan	278	260	13	5	21,212	32.2 [29.5 - 34.9]	62.7 [58.4 - 67.1]	98.2	22.2	273	4,707	66.3 [63.1 - 69.4]	63.4 [36.9 - 2.2]	5	16,505	23.1 [15.7 - 31.8]	23.5 [8.1 - 3.6]
2010-11	WINTER	Minnesota	54	44	2	8	101,255	32 [28.5 - 35.7]	50.8 [41.1 - 60.4]	83.3	9.7	45	9,818	60.4 [57.2 - 63.5]	55.4 [37.5 - 5.6]	9	91,437	28.4 [22.8 - 34.5]	27.5 [14.3 - 4.8]
2010-11	WINTER	Mississippi	16	11	0	5	96,053	26.5 [22.4 - 30.9]	12.8 [0.5 - 25]	68.8	0.1	11	126	6.1 [0.3 - 24.6]	11 [29.9 - 9]	5	95,927	26.5 [18.9 - 35.2]	16.7 [9.1 - 4.1]
2010-11	WINTER	Missouri	161	154	7	0	2,350	28.6 [24.3 - 33.1]	26 [21 - 30.9]	100.0	100.0	161	2,350	28.6 [24.3 - 33.1]	26 [32 - 2.5]	0			
2010-11	WINTER	Montana	26	19	0	7	41,933	20.4 [14.2 - 27.7]	50.6 [34.9 - 66.3]	73.1	0.3	19	121	74.4 [59 - 86.5]	61.4 [41.8 - 9.6]	7	41,812	20.2 [9.1 - 35.8]	21.1 [18.5 - 7]
2010-11	WINTER	Nebraska	16	12	2	2	79,194	29.3 [25.9 - 32.8]	29.5 [17.4 - 41.6]	81.3	1.0	13	759	14.5 [8.2 - 22.9]	32.1 [26.3 - 7.3]	3	(D)	(D)	(D)
2010-11	WINTER	Nevada	6	4	0	2	3,775	26.9 [15 - 41.6]	7.4 [-4.6 - 19.3]	66.7	0.7	4	(D)	(D)	(D)	2	(D)	(D)	(D)
2010-11	WINTER	New Hampshire	84	81	3	0	890	31.4 [25.1 - 38.1]	55.4 [47.1 - 63.6]	97.6	98.7	82	878	31.5 [25.2 - 38.3]	55.8 [38.6 - 4.3]	2	(D)	(D)	(D)
2010-11	WINTER	New Jersey	110	101	9	0	2,113	28.7 [25.3 - 32.2]	30.9 [24.2 - 37.7]	90.0	29.5	99	623	33.8 [28.1 - 39.7]	31.6 [37.7 - 3.8]	11	1,490	26.5 [20.4 - 33.2]	25.3 [18.8 - 5.7]
2010-11	WINTER	New Mexico	24	23	1	0	185	11.7 [6.5 - 18.7]	19 [5.5 - 32.6]	95.8	98.9	23	183	12 [6.7 - 19.3]	19.9 [34.4 - 7.2]	1	(D)	(D)	(D)
2010-11	WINTER	New York	217	202	12	3	7,912	58.5 [55 - 62.1]	44.2 [39.4 - 48.9]	92.2	26.6	200	2,101	37.7 [34.2 - 41.3]	44.1 [36.3 - 2.6]	17	5,811	63.3 [50.9 - 74.5]	44.5 [26.3 - 6.4]
2010-11	WINTER	North Carolina	615	597	16	2	7,423	24.7 [23.1 - 26.4]	25.8 [23.3 - 28.2]	96.4	75.6	593	5,609	23.9 [22.1 - 25.7]	25.7 [31.2 - 1.3]	22	1,814	27.3 [21.9 - 33.1]	27 [22.9 - 4.9]
2010-11	WINTER	North Dakota	21	7	2	12	131,159	24.6 [20.2 - 29.4]	33.9 [20.9 - 46.9]	38.1	0.4	8	512	69.3 [56.8 - 80.1]	55.7 [37 - 13.1]	13	130,647	24.4 [19 - 30.5]	20.5 [14.8 - 4.1]
2010-11	WINTER	Ohio	242	240	2	0	1,577	42.6 [38.5 - 46.7]	38.6 [34 - 43.3]	99.6	99.9	241	1,576	42.5 [38.5 - 46.7]	38.4 [37 - 2.4]	1	(D)	(D)	(D)
2010-11	WINTER	Oklahoma	31	28	3	0	628	16.5 [7.8 - 28.7]	29.2 [17.2 - 41.3]	93.5	98.1	29	616	16.6 [7.7 - 29.4]	30.8 [34.9 - 6.5]	2	(D)	(D)	(D)
2010-11	WINTER	Oregon	178	166	8	4	19,611	9.5 [8.3 - 10.7]	29.3 [24.4 - 34.2]	92.1	5.9	164	1,150	26.1 [22.7 - 29.7]	30.7 [34 - 2.7]	14	18,461	8.5 [6.2 - 11.2]	12.1 [16.6 - 4.4]
2010-11	WINTER	Pennsylvania	430	417	12	1	7,150	67.1 [64.2 - 69.8]	48.9 [45.2 - 52.7]	98.4	52.7	423	3,770	46.3 [43.2 - 49.4]	49 [39.9 - 1.9]	7	3,380	82.3 [69.6 - 91.5]	45.3 [27.1 - 10.2]
2010-11	WINTER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	WINTER	Rhode Island	66	66	0	0	214	48.7 [40.2 - 57.2]	46.2 [35.8 - 56.6]	95.5	94.4	63	202	49.5 [40.9 - 58.2]	46.8 [43.5 - 5.5]	3	(D)	(D)	(D)
2010-11	WINTER	South Carolina	82	75	6	1	2,757	39 [35 - 43.2]	19.9 [15 - 24.8]	89.0	21.3	73	588	19.7 [15.6 - 24.2]	17 [21.3 - 2.5]	9	2,169	43.3 [32.5 - 54.6]	43.5 [19.6 - 6.5]
2010-11	WINTER	South Dakota	18	14	0	4	78,217	31.7 [30.7 - 32.8]	23 [8.5 - 37.5]	77.8	0.1	14	80	66.7 [45.9 - 83.7]	20.7 [35.5 - 9.5]	4	(D)	(D)	(D)
2010-11	WINTER	Tennessee	90	88	2	0	691	22.3 [17.1 - 28.1]	21.7 [15.5 - 27.9]	94.4	83.4	85	576	18.5 [13.5 - 24.3]	21.4 [30.1 - 3.3]	5	115	41.7 [20.1 - 65.7]	27.6 [32.3 - 14.5]
2010-11	WINTER	Texas	76	62	2	12	112,874	25.8 [23.6 - 28.2]	20.3 [14.5 - 26]	84.2	1.4	64	1,575	33.3 [28.5 - 38.4]	20 [27 - 3.4]	12	111,299	25.7 [20.2 - 31.9]	21.7 [15.5 - 4.5]
2010-11	WINTER	Utah	117	114	1	2	4,779	29.5 [26.6 - 32.4]	32.9 [26.9 - 39]	98.3	49.6	115	2,370	19.7 [16.2 - 23.5]	33.2 [33.6 - 3.1]	2	(D)	(D)	(D)
2010-11	WINTER	Vermont	119	117	1	1	1,551	26.7 [21.7 - 32.1]	41.2 [34.5 - 47.8]	95.8	94.3	114	1,462	24.6 [19.6 - 30.2]	40.3 [37.5 - 3.5]	5	89	58.2 [45 - 70.6]	62.1 [11.8 - 5.3]
2010-11	WINTER	Virginia	406	391	15	0	4,145	31.2 [29 - 33.5]	33.6 [30.2 - 37]	95.8	58.6	389	2,429	34.5 [31.8 - 37.4]	33.7 [35.3 - 1.8]	17	1,716	26.5 [20.8 - 32.9]	30.8 [27.8 - 6.7]
2010-11	WINTER	Washington	150	138	6	6	23,991	23.4 [20.1 - 26.9]	41.6 [35.6 - 47.6]	94.7	5.9	142	1,415	40.7 [35.9 - 45.6]	43.1 [37.7 - 3.2]	8	22,576	22.5 [10.1 - 39.3]	16.1 [18.3 - 6.5]
2010-11	WINTER	West Virginia	56	54	2	0	559	54.5 [45 - 63.7]	48.3 [38 - 58.7]	91.1	85.5	51	478	53.2 [42.5 - 63.7]	46 [40 - 5.6]	5	81	60.8 [47.2 - 73.3]	71.9 [28.8 - 12.9]
2010-11	WINTER	Wisconsin	126	121	4	1	2,904	66.3 [61.7 - 70.8]	57.7 [51.3 - 64.2]	96.0	96.9	121	2,814	66.8 [62 - 71.3]	58.3 [37.2 - 3.4]	5	90	48.9 [30 - 68]	43.6 [23.6 - 10.5]
2010-11	WINTER	Wyoming	8	7	0	1	3,481	18.6 [16.5 - 20.7]	30.5 [0 - 60.9]	87.5	99.9	7	3,477	18.6 [16.4 - 20.9]	31.2 [47.5 - 17.9]	1	(D)	(D)	(D)
2010-11	WINTER	Other	0																
2010-11	WINTER	MultiStateOperation	127	58	29	40	222,437	25.3 [22.6 - 28.1]	30.7 [26.4 - 35.1]	0.0	0.0	127	222,437	25.3 [22.6 - 28.1]	30.7 [25 - 2.2]	127	222,437	25.3 [22.6 - 28.1]	30.7 [25 - 2.2]
2011-12	WINTER	Alabama	40	38	2	0	539	7.8 [3.9 - 13.4]	13.3 [6.1 - 20.5]	95.0	98.5	38	531	7.9 [3.9 - 13.7]	14 [23.7 - 3.8]	2	(D)	(D)	(D)
2011-12	WINTER	Alaska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	WINTER	Arizona	8	6	2	0	447	24.5 [15.1 - 36]	22.9 [9.2 - 36.7]	75.0	48.3	6	216	36 [25.9 - 47.1]	25.3 [22.9 - 9.3]	2	(D)	(D)	(D)
2011-12	WINTER	Arkansas	41	39	2	0	383	21.4 [14.5 - 29.6]	27 [17.5 - 36.4]	97.6	83.8	40	321	24.2 [16.7 - 32.9]	27.5 [31.2 - 4.9]	1	(D)	(D)	(D)
2011-12	WINTER	California	301	237	25	39	245,111	23.1 [21.6 - 24.6]	29.8 [26.2 - 33.4]	85.4	20.1	257	49,252	16.3 [14.1 - 18.7]	31.3 [33.9 - 2.1]	44	195,859	24.3 [20.9 - 28]	21.2 [14.9 - 2.2]
2011-12	WINTER	Colorado	129	124	5	0	1,227	31.5 [27.6 - 35.6]	39 [33.3 - 44.7]	98.4	78.0	127	957	36.1 [31.9 - 40.4]	39.4 [33.1 - 2.9]	2	(D)	(D)	(D)
2011-12	WINTER	Connecticut	60	58	2	0	682	23.7 [17.5 - 30.7]	35.2 [25.6 - 44.8]	91.7	73.0	55	498	28.5 [21.8 - 36]	36.7 [38.7 - 5.2]	5	184	10.6 [0.9 - 35.7]	19 [25.6 - 11.4]
2011-12	WINTER	District of Columbia	11	8	1	2	3,062	23.8 [9.4 - 44.2]	12.2 [-0.7 - 25.2]	90.9	94.2	10	2,884	24.4 [9 - 46.4]	11.9 [23.1 - 7.3]	1	(D)	(D)	(D)
2011-12	WINTER	Delaware	29	27	2	0	420	47.8 [37.4 - 58.2]	31.6 [19.8 - 43.5]	89.7	48.8	26	205	29.6 [18.7 - 42.3]	28.6 [32.5 - 6.4]	3	(D)	(D)	(D)
2011-12	WINTER	Florida	106	86	8	12	35,153	24.6 [22.1 - 27.3]	22.3 [17.1 - 27.5]	90.6	31.8	96	11,173	20.8 [18.4 - 23.3]	22.1 [28 - 2.9]	10	23,980	26.1 [17.6 - 35.8]	24.3 [18.6 - 5.9]
2011-12	WINTER	Georgia	148	141	3	4	10,446	40.1 [38.3 - 41.9]	22.2 [17.8 - 26.6]	93.9	14.5	139	1,519	22.1 [18.1 - 26.6]	21.9 [27.6 - 2.3]	9	8,927	42.2 [38.9 - 45.5]	27.2 [19.2 - 6.4]
2011-12	WINTER	Hawaii	29	24	2	3	9,903	5.5 [3.6 - 7.9]	23.5 [12.9 - 34]	100.0	100.0	29	9,903	5.5 [3.6 - 7.9]	23.5 [29 - 5.4]	0			
2011-12	WINTER	Idaho	42	38	0	4	12,203	11.5 [9.4 - 13.8]	34.8 [23.5 - 46.2]	90.5	56.7	38	6,921	12.5 [10.7 - 14.5]	36.4 [38.6 - 6.3]	4	(D)	(D)	(D)
2011-12	WINTER	Illinois	93	91	2	0	1,085	41.9 [36.7 - 47.2]	29.4 [22.7 - 36.1]	97.8	66.9	91	726	33.9 [28.4 - 39.8]	28.9 [33.1 - 3.5]	2	(D)	(D)	(D)
2011-12	WINTER	Indiana	88	85	2	1	2,168	10.9 [8.3 - 13.9]	20.5 [14.8 - 26.3]	96.6	36.6	85	794	16.7 [12.7 - 21.3]	21.2 [27.9 - 3]	3	(D)	(D)	(D)
2011-12	WINTER	Iowa	39	34	4	1	1,525	40.4 [35 - 45.9]	15 [8.7 - 21.3]	97.4	76.7	38	1,170	36.3 [31.2 - 41.7]	13.9 [19 - 3.1]	1	(D)	(D)	(D)
2011-12	WINTER	Kansas	23	20	3	0	534	22.6 [14.9 - 31.9]	21.5 [9.9 - 33]	91.3	46.6	21	249	24.6 [14 - 37.9]	21.4 [29.3 - 6.4]	2	(D)	(D)	(D)
2011-12	WINTER	Kentucky	46	44	2	0	705	30.5 [25 - 36.4]	25.6 [16.8 - 34.3]	97.8	92.9	45	655	32.2 [26.9 - 37.9]	26.1 [30.4 - 4.5]	1	(D)	(D)	(D)
2011-12	WINTER	Louisiana	23	20	2	1	2,514	9.7 [7.3 - 12.6]	19 [7.5 - 30.5]	100.0	100.0	23	2,514	9.7 [7.3 - 12.6]	19 [28.1 - 5.9]	0			
2011-12	WINTER	Maine	139	131	4	4	20,812	25.8 [23.9 - 27.7]	13.8 [9.8 - 17.7]	95.0	4.7	132	978	11.6 [9.2 - 14.2]	13.3 [24 - 2.1]	7	19,834	26.1 [17.9 - 35.7]	21.6 [15.3 - 5.8]
2011-12	WINTER	Maryland	335	330	5	0	2,187	26.6 [23.9 - 29.4]	18.3 [15.1 - 21.6]	97.9	72.0	328	1,574	22.8 [20.1 - 25.6]	18.1 [30.7 - 1.7]	7	613	38.1 [21.6 - 56.8]	29.1 [30.7 - 11.6]
2011-12	WINTER	Massachusetts	221	215	4	2	12,212	19.4 [18.2 - 20.7]	30.2 [25.5 - 34.9]	96.4	16.6	213	2,030	22.8 [19.4 - 26.5]	30.4 [36 - 2.5]	8	10,182	19 [17.1 - 20.9]	22.9 [23.5 - 8.3]
2011-12	WINTER	Michigan	237	221	12	4	9,293	17.6 [15.2 - 20.1]	28.6 [24.2 - 33.1]	98.3	38.2	233	3,548	25.6 [22.7 - 28.7]	28.8 [35.3 - 2.3]	4	(D)	(D)	(D)
2011-12	WINTER	Minnesota	63	62	1	0	757	31 [25.8 - 36.5]	42.8 [33.1 - 52.4]	98.4	98.0	62	742	31.6 [26.4 - 37.1]	43.4 [39.1 - 5]	1	(D)	(D)	(D)
2011-12	WINTER	Mississippi	13	11	0	2	72,290	34.2 [32.9 - 35.6]	14.3 [5.5 - 23.1]	84.6	0.1	11	90	7.4 [2.6 - 15.4]	9.9 [13.1 - 4]	2	(D)	(D)	(D)
2011-12	WINTER	Missouri	97	88	9	0	1,454	11.7 [9.7 - 14]	14.7 [10.6 - 18.8]	97.9	86.7	95	1,261	11.6 [9.5 - 14]	14.9 [20.6 - 2.1]	2	(D)	(D)	(D)
2011-12	WINTER	Montana	33	26	1	6	22,862	7.4 [5.2 - 10.1]	12.2 [5.1 - 19.3]	81.8	5.3	27	1,207	19.5 [17.6 - 21.4]	11.6 [22.9 - 4.3]	6	21,655	6.6 [2.5 - 13.6]	15 [13.6 - 5.5]
2011-12	WINTER	Nebraska	9	8	0	1	9,038	23.4 [22.1 - 24.7]	39.8 [16.1 - 63.5]	88.9	0.4	8	38	36.8 [14.5 - 64]	41.9 [38.2 - 13.5]	1	(D)	(D)	(D)
2011-12	WINTER	Nevada	18	15	2	1	1,660	28.1 [24.8 - 31.5]	34.2 [16.3 - 52.1]	77.8	4.0	14	67	26.5 [12.9 - 44]	36.9 [42.9 - 11.5]	4	(D)	(D)	(D)
2011-12	WINTER	New Hampshire	63	60	3	0	857	19.5 [15.6 - 23.7]	17.5 [10.8 - 24.3]	92.1	83.5	58	716	17.4 [13.5 - 21.9]	17.6 [28.1 - 3.7]	5	141	29.8 [19.4 - 41.8]	17 [19 - 8.5]
2011-12	WINTER	New Jersey	72	68	3	1	5,195	18.6 [17.1 - 20.1]	18.1 [11.6 - 24.6]	87.5	10.7	63	554	11.5 [7.9 - 16.1]	15.4 [26.7 - 3.4]	9	4,641	19.1 [16.2 - 22.3]	36.6 [31.3 - 10.4]
2011-12	WINTER	New Mexico	14	13	1	0	214	36.2 [29 - 43.9]	22.8 [9.2 - 36.4]	100.0	100.0	14	214	36.2 [29 - 43.9]	22.8 [26 - 7]	0			
2011-12	WINTER	New York	191	175	12	4	14,102	28.9 [26.8 - 30.9]	25.5 [21.1 - 29.9]	92.7	16.5	177	2,324	20.6 [17.8 - 23.6]	26 [32.2 - 2.4]	14	11,778	29.7 [22.8 - 37.4]	18.4 [14.4 - 3.9]
2011-12	WINTER	North Carolina	431	424	6	1	3,917	26.7 [24.4 - 29]	21.2 [18.6 - 23.9]	97.9	82.0	422	3,210	21.1 [18.9 - 23.3]	21 [28.2 - 1.4]	9	707	50.8 [43.3 - 58.3]	31.6 [24 - 8]
2011-12	WINTER	North Dakota	12	1	2	9	60,837	17.8 [12.7 - 23.9]	17.5 [9.1 - 25.9]	16.7	3.5	2	(D)	(D)	(D)	10	58,732	18.2 [12.6 - 24.9]	20.5 [14.4 - 4.6]
2011-12	WINTER	Ohio	231	222	7	2	4,714	26.5 [23.6 - 29.5]	27.6 [23.3 - 31.9]	98.3	69.6	227	3,279	33.3 [30.4 - 36.3]	27.9 [33.5 - 2.2]	4	(D)	(D)	(D)
2011-12	WINTER	Oklahoma	28	28	0	0	158	19.3 [11.1 - 29.7]	20.6 [9.3 - 31.9]	100.0	100.0	28	158	19.3 [11.1 - 29.7]	20.6 [30.5 - 5.8]	0			
2011-12	WINTER	Oregon	144	127	9	8	36,105	13 [11.4 - 14.7]	36.1 [30.1 - 42.1]	91.7	19.8	132	7,136	25.4 [23.5 - 27.3]	37.6 [37.7 - 3.3]	12	28,969	9.9 [6.2 - 14.6]	18.9 [19.3 - 5.6]
2011-12	WINTER	Pennsylvania	703	680	21	2	11,357	37.7 [36.4 - 39]	28.4 [25.8 - 31]	97.0	42.8	682	4,865	28.4 [26.4 - 30.5]	28.5 [35.5 - 1.4]	21	6,492	41.5 [37.9 - 45.1]	26.7 [23.2 - 5.1]
2011-12	WINTER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	WINTER	Rhode Island	31	31	0	0	152	12.9 [6.5 - 21.9]	17.8 [7.5 - 28]	96.8	98.0	30	149	13.2 [6.6 - 22.3]	18.3 [29.4 - 5.4]	1	(D)	(D)	(D)
2011-12	WINTER	South Carolina	86	81	4	1	5,926	18.9 [17.1 - 20.8]	22.4 [16.4 - 28.4]	95.3	13.4	82	793	25.7 [19.7 - 32.3]	22.9 [29 - 3.2]	4	(D)	(D)	(D)
2011-12	WINTER	South Dakota	7	5	0	2	28,448	15.1 [6.4 - 27.9]	19 [4.2 - 33.9]	71.4	0.2	5	48	18.4 [8.5 - 32.2]	16.3 [20.5 - 9.2]	2	(D)	(D)	(D)
2011-12	WINTER	Tennessee	102	97	5	0	1,246	16.4 [13.4 - 19.7]	14.1 [10.4 - 17.7]	95.1	84.0	97	1,047	14 [11.2 - 17.2]	13.9 [19 - 1.9]	5	199	28.5 [14.8 - 45.5]	16.6 [19.7 - 8.8]
2011-12	WINTER	Texas	48	44	2	2	78,694	32.4 [31.3 - 33.6]	19.8 [11.7 - 27.9]	91.7	0.6	44	504	26.4 [20.3 - 33]	20.3 [29.6 - 4.5]	4	(D)	(D)	(D)
2011-12	WINTER	Utah	85	82	2	1	4,962	13.4 [10.8 - 16.4]	45.2 [37.5 - 53]	97.6	9.8	83	484	39.5 [33.4 - 45.9]	45.9 [36.6 - 4]	2	(D)	(D)	(D)
2011-12	WINTER	Vermont	89	84	4	1	1,923	18.1 [13.8 - 23.1]	35.3 [28.2 - 42.5]	95.5	40.0	85	770	33.3 [28 - 39]	35.6 [34.4 - 3.7]	4	(D)	(D)	(D)
2011-12	WINTER	Virginia	533	528	5	0	3,343	18.4 [16.6 - 20.4]	19.7 [17.3 - 22.1]	98.3	98.0	524	3,276	18.3 [16.4 - 20.2]	19.5 [28.2 - 1.2]	9	67	26.5 [14.6 - 41.3]	27.9 [19.2 - 6.4]
2011-12	WINTER	Washington	130	113	10	7	45,444	18 [16.2 - 19.8]	34.8 [28.7 - 40.9]	93.1	5.9	121	2,690	23.1 [19.2 - 27.3]	36.1 [36.2 - 3.3]	9	42,754	17.7 [12 - 24.5]	17.3 [10.3 - 3.4]
2011-12	WINTER	West Virginia	51	47	4	0	826	31.3 [24.8 - 38.4]	18.1 [12 - 24.1]	88.2	38.1	45	315	14 [9.9 - 19]	17.2 [21.9 - 3.3]	6	511	41.5 [22.8 - 62]	24.5 [23 - 9.4]
2011-12	WINTER	Wisconsin	138	132	6	0	1,594	19.4 [16 - 23.1]	28.7 [23.3 - 34.1]	96.4	89.3	133	1,423	23.3 [19.8 - 27]	28.9 [32.6 - 2.8]	5	171	2.3 [0 - 23]	22.9 [25 - 11.2]
2011-12	WINTER	Wyoming	6	5	0	1	3,372	10.7 [9.7 - 11.8]	14.3 [-1.8 - 30.3]	100.0	100.0	6	3,372	10.7 [9.7 - 11.8]	14.3 [20.1 - 8.2]	0			
2011-12	WINTER	Other	0																
2011-12	WINTER	MultiStateOperation	117	52	30	35	211,884	24.5 [22.3 - 26.8]	22.2 [18.5 - 25.8]	0.0	0.0	117	211,884	24.5 [22.3 - 26.8]	22.2 [20.1 - 1.9]	117	211,884	24.5 [22.3 - 26.8]	22.2 [20.1 - 1.9]
2012-13	WINTER	Alabama	50	45	4	1	2,667	15.8 [9.9 - 23.1]	19.2 [11.4 - 26.9]	94.0	93.1	47	2,484	8.3 [5.7 - 11.4]	16.4 [26.1 - 3.8]	3	(D)	(D)	(D)
2012-13	WINTER	Alaska	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	WINTER	Arizona	13	12	0	1	2,069	12.6 [10.4 - 15]	18.1 [6.1 - 30.1]	92.3	2.2	12	45	23.6 [12.2 - 38.5]	18.6 [23 - 6.6]	1	(D)	(D)	(D)
2012-13	WINTER	Arkansas	56	53	1	2	1,988	13.9 [11.7 - 16.4]	22.5 [14.2 - 30.9]	98.2	96.2	55	1,913	13.5 [11.2 - 16.1]	22.6 [32.1 - 4.3]	1	(D)	(D)	(D)
2012-13	WINTER	California	292	163	36	93	490,737	28.1 [26.2 - 30.1]	37.4 [33.8 - 40.9]	67.8	15.8	198	77,769	28 [25.2 - 30.8]	40.3 [34.1 - 2.4]	94	412,968	28.1 [24.8 - 31.5]	31.3 [22.8 - 2.4]
2012-13	WINTER	Colorado	314	310	4	0	1,694	47.3 [44.1 - 50.5]	40.1 [35.7 - 44.5]	97.8	88.6	307	1,501	47.7 [44.3 - 51.2]	40 [39.9 - 2.3]	7	193	44.7 [34.1 - 55.6]	46.8 [30.3 - 11.5]

			All operations in the State									Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2012-13	WINTER	Connecticut	78	75	3	0	1,009	52.4 [46.1 - 58.7]	49.3 [40.5 - 58.1]	92.3	71.2	72	718	58.5 [51.7 - 65]	49.3 [40 - 4.7]	6	291	37.9 [21.2 - 56.8]	49.3 [35.9 - 14.7]
2012-13	WINTER	District of Columbia	14	12	2	0	300	54.7 [43.9 - 65.2]	65.1 [49.3 - 80.8]	78.6	10.3	11	31	63.2 [45.3 - 78.8]	65.9 [32.9 - 9.9]	3	(D)	(D)	(D)
2012-13	WINTER	Delaware	33	29	2	2	10,010	17.1 [12.1 - 22.9]	40.1 [29.2 - 50.9]	87.9	3.0	29	302	55.4 [46 - 64.6]	40.7 [33.2 - 6.2]	4	(D)	(D)	(D)
2012-13	WINTER	Florida	136	107	14	15	49,702	24.7 [21.8 - 27.7]	22.4 [18.2 - 26.7]	82.4	11.4	112	5,670	14.4 [11.6 - 17.5]	21.7 [26.2 - 2.5]	24	44,032	25.8 [19.2 - 33.3]	25.6 [20.2 - 4.1]
2012-13	WINTER	Georgia	117	108	6	3	9,483	43.3 [38.9 - 47.8]	37.3 [31.2 - 43.4]	88.9	10.3	104	980	29 [23.5 - 35]	37.9 [34.4 - 3.4]	13	8,503	44.7 [31.8 - 58.2]	32.5 [27.6 - 7.7]
2012-13	WINTER	Hawaii	61	50	7	4	12,900	11 [7.3 - 15.6]	19.5 [12.4 - 26.5]	98.4	96.5	60	12,450	10 [6.4 - 14.6]	19.2 [28.3 - 3.7]	1	(D)	(D)	(D)
2012-13	WINTER	Idaho	41	24	5	12	66,660	20.8 [16.5 - 25.5]	42.1 [32.7 - 51.6]	56.1	2.6	23	1,764	24.3 [18.5 - 30.8]	54.8 [31.3 - 6.5]	18	64,896	20.7 [14.4 - 28.2]	25.9 [21.8 - 5.1]
2012-13	WINTER	Illinois	202	199	2	1	5,281	27.9 [25.3 - 30.6]	47.9 [42.7 - 53.2]	98.0	28.7	198	1,518	41.8 [37.5 - 46.3]	47.8 [38 - 2.7]	4	(D)	(D)	(D)
2012-13	WINTER	Indiana	173	166	6	1	4,030	24.5 [22.2 - 26.9]	36.4 [31.8 - 40.9]	97.1	44.3	168	1,786	30.6 [27.1 - 34.2]	36.4 [30.9 - 2.4]	5	2,244	20.4 [17.9 - 23.1]	36.7 [19 - 8.5]
2012-13	WINTER	Iowa	63	51	10	2	6,535	28.8 [24 - 33.9]	49.7 [41.9 - 57.4]	93.7	39.3	59	2,566	38.9 [31.9 - 46.3]	51.2 [31.5 - 4.1]	4	(D)	(D)	(D)
2012-13	WINTER	Kansas	51	44	6	1	2,329	30.3 [25.5 - 35.4]	29.4 [20.9 - 37.9]	86.3	19.0	44	443	27.4 [19.6 - 36.3]	29.1 [32.4 - 4.9]	7	1,886	30.9 [20 - 43.5]	30.9 [19.1 - 7.2]
2012-13	WINTER	Kentucky	67	63	4	0	749	33.2 [27.3 - 39.6]	52.4 [44 - 60.8]	95.5	92.3	64	691	34.1 [27.9 - 40.8]	53.2 [35.5 - 4.4]	3	(D)	(D)	(D)
2012-13	WINTER	Louisiana	22	20	1	1	2,264	18.4 [16.7 - 20.1]	11.8 [6.5 - 17.1]	100.0	100.0	22	2,264	18.4 [16.7 - 20.1]	11.8 [12.6 - 2.7]	0			
2012-13	WINTER	Maine	177	169	3	5	47,851	21.1 [19.5 - 22.8]	42.6 [37.2 - 48]	96.6	2.6	171	1,234	30.3 [26.2 - 34.7]	43.3 [37.1 - 2.8]	6	46,617	20.9 [12.8 - 31]	22.9 [17.8 - 7.3]
2012-13	WINTER	Maryland	271	260	9	2	11,840	21.2 [18.8 - 23.7]	57 [52.7 - 61.4]	96.3	15.5	261	1,834	52.8 [49.4 - 56.2]	57.3 [36.8 - 2.3]	10	10,006	16.9 [8.7 - 28.2]	49.2 [26.2 - 8.3]
2012-13	WINTER	Massachusetts	245	241	2	2	17,896	21.9 [20.5 - 23.4]	53.9 [48.9 - 58.8]	98.0	10.5	240	1,874	40.9 [36.8 - 45.1]	54.3 [39.5 - 2.5]	5	16,022	20 [18.9 - 21.2]	30.9 [39.5 - 17.7]
2012-13	WINTER	Michigan	313	293	15	5	23,519	21.6 [19.2 - 24]	56.8 [52.8 - 60.8]	97.8	16.7	306	3,917	58.4 [55 - 61.7]	57.2 [36.1 - 2.1]	7	19,602	15.9 [7.5 - 27.8]	37.9 [43.9 - 16.6]
2012-13	WINTER	Minnesota	117	101	2	14	53,734	38.7 [35.2 - 42.4]	65.7 [60 - 71.4]	86.3	25.5	101	13,688	60.6 [59.5 - 61.7]	70.1 [29.7 - 3]	16	40,046	31.8 [23.4 - 41]	37.9 [28.7 - 7.2]
2012-13	WINTER	Mississippi	41	31	6	4	89,705	37.6 [35.3 - 39.9]	29.4 [20.7 - 38.1]	87.8	1.8	36	1,630	21.6 [16.3 - 27.7]	29.6 [30 - 5]	5	88,075	37.9 [31.3 - 44.7]	28.1 [12.8 - 5.7]
2012-13	WINTER	Missouri	104	98	6	0	1,596	22.9 [19 - 27.2]	24.6 [19.3 - 29.9]	97.1	72.1	101	1,150	22.8 [18.9 - 27]	24.2 [27.7 - 2.8]	3	(D)	(D)	(D)
2012-13	WINTER	Montana	46	30	3	13	63,014	17.4 [13 - 22.5]	44.9 [35.6 - 54.2]	63.0	1.7	29	1,066	50.3 [46 - 54.7]	53 [33.1 - 6.1]	17	61,948	16.9 [10.1 - 25.5]	31.2 [26.2 - 6.3]
2012-13	WINTER	Nebraska	23	19	1	3	77,173	37.9 [34.2 - 41.6]	47.8 [34.9 - 60.7]	73.9	0.4	17	327	31.5 [17.7 - 48.1]	48.7 [32.6 - 7.9]	6	76,846	37.9 [30.6 - 45.6]	45.1 [31.2 - 12.7]
2012-13	WINTER	Nevada	11	7	2	2	6,720	32.2 [24.4 - 40.8]	27.5 [7.9 - 47.1]	63.6	0.3	7	19	20 [4.1 - 48.3]	21.9 [36.9 - 13.9]	4	(D)	(D)	(D)
2012-13	WINTER	New Hampshire	96	93	3	0	898	35.1 [29.4 - 41.2]	46.5 [38.2 - 54.9]	99.0	87.3	95	784	34 [27.9 - 40.5]	46.6 [42 - 4.3]	1	(D)	(D)	(D)
2012-13	WINTER	New Jersey	87	84	1	2	24,746	17.1 [15.6 - 18.7]	43.1 [35.1 - 51.2]	92.0	2.6	80	635	43.8 [37.9 - 49.9]	43.7 [39 - 4.4]	7	24,111	16.5 [12.8 - 20.9]	37.1 [29.5 - 11.1]
2012-13	WINTER	New Mexico	27	27	0	0	128	33.1 [21.5 - 46.3]	35.3 [22.6 - 48.1]	92.6	89.8	25	115	32.7 [20.4 - 47]	35 [35 - 7]	2	(D)	(D)	(D)
2012-13	WINTER	New York	270	247	11	12	46,196	26.5 [24 - 29.2]	43.9 [39.8 - 48]	93.0	13.7	251	6,313	55.8 [51.5 - 60]	44.5 [34.8 - 2.2]	19	39,883	23 [15.9 - 31.2]	36.5 [22.3 - 5.1]
2012-13	WINTER	North Carolina	415	405	9	1	5,181	34.1 [31.5 - 36.8]	43.4 [39.9 - 46.9]	96.6	82.6	401	4,280	39.1 [36.4 - 41.9]	43.7 [36.6 - 1.8]	14	901	16.5 [8.4 - 27.7]	33.6 [27.9 - 7.5]
2012-13	WINTER	North Dakota	39	5	1	33	220,230	25.9 [20.9 - 31.3]	35.5 [27.2 - 43.7]	10.3	0.0	4	(D)	(D)	(D)	35	220,205	25.9 [20.7 - 31.6]	29.1 [18.8 - 3.2]
2012-13	WINTER	Ohio	281	273	6	2	11,989	18.6 [16.5 - 20.7]	48.7 [44.6 - 52.8]	99.3	33.1	279	3,968	42.2 [39.4 - 45.1]	48.9 [35.1 - 2.1]	2	(D)	(D)	(D)
2012-13	WINTER	Oklahoma	37	34	2	1	3,389	14.1 [11.5 - 17]	18.9 [10.6 - 27.1]	94.6	8.9	35	301	26.1 [18.5 - 34.8]	19.4 [26.2 - 4.4]	2	(D)	(D)	(D)
2012-13	WINTER	Oregon	194	178	10	6	37,938	26.5 [24.3 - 28.9]	38.1 [33.1 - 43.2]	93.3	23.5	181	8,925	24.7 [23 - 26.6]	38.8 [36.5 - 2.7]	13	29,013	27 [18.2 - 37.2]	29.4 [23.3 - 6.4]
2012-13	WINTER	Pennsylvania	565	538	22	5	25,443	27.9 [25.9 - 30]	52 [48.9 - 55.1]	97.0	22.0	548	5,601	46.1 [43.5 - 48.8]	52.5 [37.6 - 1.6]	17	19,842	24.5 [14.9 - 36.2]	35.4 [24.4 - 5.9]
2012-13	WINTER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	WINTER	Rhode Island	28	28	0	0	205	34.7 [27 - 42.9]	36.7 [23.6 - 49.7]	78.6	60.0	22	123	37 [26.8 - 48.1]	41 [37.6 - 8]	6	82	31.5 [20.8 - 43.7]	20.6 [18.2 - 7.4]
2012-13	WINTER	South Carolina	97	94	2	1	4,097	15.5 [11.6 - 19.9]	40.4 [33.9 - 46.8]	97.9	22.7	95	932	39 [33.9 - 44.2]	40.1 [31.9 - 3.3]	2	(D)	(D)	(D)
2012-13	WINTER	South Dakota	8	4	0	4	77,790	39 [35.5 - 42.6]	46.6 [24.7 - 68.4]	62.5	3.4	5	2,661	36.9 [32.7 - 41.2]	57.4 [35.2 - 15.8]	3	(D)	(D)	(D)
2012-13	WINTER	Tennessee	94	88	6	0	1,280	43.1 [37.3 - 49]	35.8 [29.3 - 42.2]	94.7	69.2	89	886	33.4 [28.4 - 38.7]	35.4 [32 - 3.4]	5	394	58.6 [31.3 - 82.6]	41.6 [29.4 - 13.2]
2012-13	WINTER	Texas	77	58	4	15	80,014	36.5 [32.9 - 40.3]	26.7 [20.8 - 32.6]	77.9	1.0	60	764	21.7 [16.7 - 27.4]	23.8 [27.9 - 3.6]	17	79,250	36.6 [28.9 - 44.9]	37 [17.1 - 4.1]
2012-13	WINTER	Utah	80	70	6	4	12,897	40.8 [34.6 - 47.2]	52.5 [45 - 60]	90.0	5.5	72	712	67.7 [62.2 - 73]	53.1 [34.5 - 4.1]	8	12,185	39.2 [20.5 - 60.4]	47.2 [33.5 - 11.9]
2012-13	WINTER	Vermont	76	67	6	3	4,152	27.1 [23.3 - 31.1]	40.6 [32.7 - 48.5]	93.4	58.7	71	2,437	30.8 [26.9 - 34.9]	40.4 [35.7 - 4.2]	5	1,715	21.5 [8.8 - 39.5]	43.3 [30 - 13.4]
2012-13	WINTER	Virginia	699	685	12	2	14,752	22.9 [21.3 - 24.6]	44.3 [41.7 - 47]	97.9	33.2	684	4,904	42 [39.7 - 44.2]	44.5 [36.4 - 1.4]	15	9,848	16.4 [9.7 - 25]	38.4 [28 - 7.2]
2012-13	WINTER	Washington	178	164	6	8	69,593	22.7 [21.3 - 24.1]	45.3 [39.8 - 50.8]	93.3	2.1	166	1,493	34.3 [30.4 - 38.3]	46.7 [38.1 - 3]	12	68,100	22.5 [17.7 - 27.8]	26.5 [15.7 - 4.5]
2012-13	WINTER	West Virginia	86	83	2	1	2,562	45.4 [41 - 49.9]	38.1 [30.8 - 45.3]	94.2	31.0	81	794	26.1 [20.6 - 32.2]	37.7 [34.7 - 3.9]	5	1,768	54.2 [46 - 62.3]	44.6 [29.7 - 13.3]
2012-13	WINTER	Wisconsin	184	165	12	7	20,854	23.3 [20.3 - 26.6]	62.8 [57.8 - 67.7]	94.6	26.8	174	5,581	51.2 [46.4 - 55.9]	64.4 [33.7 - 2.6]	10	15,273	15.6 [11.4 - 20.6]	34.9 [36.2 - 11.5]
2012-13	WINTER	Wyoming	21	13	3	5	16,355	37.5 [27 - 48.9]	33.5 [18.3 - 48.8]	61.9	1.2	13	194	22.7 [9.6 - 41]	25.5 [39.6 - 11]	8	16,161	37.7 [20.8 - 56.9]	46.6 [25.3 - 8.9]
2012-13	WINTER	Other	0																
2012-13	WINTER	MultiStateOperation	197	68	42	87	451,785	28.9 [26.6 - 31.4]	35.1 [31.5 - 38.6]	0.0	0.0	197	451,785	28.9 [26.6 - 31.4]	35.1 [25.6 - 1.8]	197	451,785	28.9 [26.6 - 31.4]	35.1 [25.6 - 1.8]
2013-14	WINTER	Alabama	38	37	1	0	345	11.2 [6.2 - 18]	20.8 [14 - 27.5]	94.7	74.5	36	257	22.9 [17.2 - 29.4]	20.1 [20.4 - 3.4]	2	(D)	(D)	(D)
2013-14	WINTER	Alaska	5	5	0	0	21	38.1 [18.6 - 60.7]	34.8 [11.1 - 58.4]	100.0	100.0	5	21	38.1 [18.6 - 60.7]	34.8 [27 - 12.1]	0			
2013-14	WINTER	Arizona	6	5	1	0	362	34.5 [21.1 - 49.9]	22 [-10.3 - 54.2]	83.3	98.3	5	356	35.1 [20.6 - 51.8]	26.4 [43.4 - 19.4]	1	(D)	(D)	(D)
2013-14	WINTER	Arkansas	74	69	3	2	8,676	16.1 [13.5 - 18.8]	32.7 [25.5 - 39.9]	94.6	7.8	70	679	48.2 [42.1 - 54.3]	33.9 [32 - 3.8]	4	(D)	(D)	(D)
2013-14	WINTER	California	293	187	28	78	392,531	20.6 [19 - 22.3]	32.3 [28.6 - 36]	67.9	8.9	199	34,880	19.8 [17.5 - 22.3]	37.9 [36.7 - 2.6]	94	357,651	20.7 [18 - 23.7]	20.4 [16.3 - 1.7]
2013-14	WINTER	Colorado	224	222	1	1	68,982	17.8 [17.3 - 18.3]	35.4 [30.4 - 40.4]	97.8	1.2	219	850	29.7 [25.8 - 33.7]	35.7 [38.6 - 2.6]	5	68,132	17.7 [16.8 - 18.5]	23.2 [21 - 9.4]
2013-14	WINTER	Connecticut	77	73	4	0	816	39.4 [33.6 - 45.5]	48.2 [39.3 - 57.1]	90.9	68.3	70	557	48 [41.9 - 54.1]	50.5 [40.1 - 4.8]	7	259	21 [9.8 - 36.4]	24.7 [26.7 - 10.1]
2013-14	WINTER	District of Columbia	8	7	1	0	192	70.7 [54 - 84.3]	37.9 [5.9 - 69.8]	62.5	9.9	5	19	21.1 [3.6 - 53]	45.1 [50.4 - 22.5]	3	(D)	(D)	(D)
2013-14	WINTER	Delaware	28	27	0	1	10,160	25.2 [24.1 - 26.3]	37.6 [24.6 - 50.6]	78.6	0.7	22	73	32.4 [20.6 - 46]	36.9 [38.4 - 8.2]	6	10,087	25.1 [23.4 - 26.9]	40.3 [21 - 8.6]
2013-14	WINTER	Florida	166	137	9	20	51,693	20.6 [18.6 - 22.8]	25.7 [21.4 - 30.1]	81.9	7.1	136	3,656	24.9 [22.3 - 27.7]	26.3 [29.9 - 2.6]	30	48,037	20.3 [15.6 - 25.7]	23.1 [23.1 - 4.2]
2013-14	WINTER	Georgia	107	95	6	6	12,352	25.9 [21.9 - 30.3]	31.8 [25.1 - 38.5]	87.9	12.4	94	1,528	21.8 [17.2 - 26.9]	31.8 [36.1 - 3.7]	13	10,824	26.5 [15.7 - 39.7]	31.9 [31.6 - 8.8]
2013-14	WINTER	Hawaii	75	68	4	3	13,511	13.2 [11.1 - 15.5]	15.1 [9.7 - 20.5]	98.7	48.2	74	6,511	13.1 [10.1 - 16.4]	15.1 [23.9 - 2.8]	1	(D)	(D)	(D)
2013-14	WINTER	Idaho	41	22	2	17	96,469	13.4 [11.6 - 15.2]	25.2 [17.5 - 33]	61.0	8.4	25	8,077	12.8 [11.1 - 14.6]	32.4 [29.8 - 6]	16	88,392	13.4 [10.6 - 16.6]	14 [7.7 - 1.9]
2013-14	WINTER	Illinois	159	155	3	1	2,438	60.5 [57.4 - 63.4]	59.6 [54 - 65.2]	96.2	47.5	153	1,158	61.1 [56.6 - 65.4]	58.9 [36.4 - 2.9]	6	1,280	59.9 [55.4 - 64.2]	76.5 [20.5 - 8.4]
2013-14	WINTER	Indiana	216	210	5	1	3,713	33.1 [28.6 - 37.9]	64.5 [59.8 - 69.2]	96.8	49.0	209	1,821	65.6 [61.6 - 69.5]	65 [35.1 - 2.4]	7	1,892	7.9 [2.7 - 16.6]	48.5 [33.2 - 12.5]
2013-14	WINTER	Iowa	61	57	4	0	1,257	50.2 [42.9 - 57.6]	51.9 [43.2 - 60.5]	96.7	83.2	59	1,046	57 [49.9 - 63.9]	52.9 [34.6 - 4.5]	2	(D)	(D)	(D)
2013-14	WINTER	Kansas	43	41	2	0	575	44 [35.3 - 53]	37 [27.8 - 46.2]	95.3	64.5	41	371	27.9 [21.4 - 35]	36.2 [30.8 - 4.8]	2	(D)	(D)	(D)
2013-14	WINTER	Kentucky	112	105	7	0	1,500	36.8 [32.4 - 41.4]	42.3 [35.8 - 48.9]	96.4	73.0	108	1,095	37.9 [33.3 - 42.6]	41.8 [35.3 - 3.4]	4	(D)	(D)	(D)
2013-14	WINTER	Louisiana	22	19	1	2	9,276	16 [13.7 - 18.5]	24.5 [13.3 - 35.6]	95.5	24.5	21	2,276	24.7 [22.3 - 27.2]	25 [27.2 - 5.9]	1	(D)	(D)	(D)
2013-14	WINTER	Maine	166	160	2	4	29,096	26.9 [25.5 - 28.4]	40 [34.3 - 45.6]	96.4	3.6	160	1,050	34.9 [30.9 - 39]	40 [37.7 - 3]	6	28,046	26.7 [19.7 - 34.5]	39 [21 - 8.6]
2013-14	WINTER	Maryland	192	187	3	2	11,871	26.7 [25.2 - 28.1]	42.2 [37 - 47.4]	93.2	13.4	179	1,586	37.7 [34 - 41.6]	42.2 [37.3 - 2.8]	13	10,285	25.5 [22.4 - 28.9]	41.7 [29.8 - 8.3]
2013-14	WINTER	Massachusetts	196	190	4	2	10,490	25.4 [23.1 - 27.8]	52.2 [46.7 - 57.7]	95.4	18.2	187	1,913	35 [30.2 - 40]	53.5 [39.9 - 2.9]	9	8,577	22.9 [20.1 - 25.8]	25 [12.7 - 4.2]
2013-14	WINTER	Michigan	460	439	12	9	24,523	30.6 [28.6 - 32.7]	69.5 [66.4 - 72.5]	97.0	19.7	446	4,829	61.1 [58.7 - 63.4]	70.6 [33 - 1.6]	14	19,694	23.5 [16.5 - 31.7]	32.7 [24.2 - 6.5]
2013-14	WINTER	Minnesota	140	123	6	11	97,604	21.3 [19.4 - 23.2]	56.3 [50.1 - 62.5]	90.0	2.6	126	2,586	47.7 [43.2 - 52.3]	59.6 [37.3 - 3.3]	14	95,018	20.6 [15.5 - 26.5]	26 [22.9 - 6.1]
2013-14	WINTER	Mississippi	23	15	2	6	85,643	21 [18.8 - 23.2]	26 [16.7 - 35.3]	65.2	0.3	15	224	25.4 [15.3 - 37.7]	26.6 [27.1 - 7]	8	85,419	21 [17.3 - 24.9]	25 [12.8 - 4.5]
2013-14	WINTER	Missouri	97	93	4	0	1,396	34.4 [29.7 - 39.4]	32.3 [25.9 - 38.6]	96.9	83.4	94	1,164	30.8 [25.9 - 35.9]	31.6 [32.1 - 3.3]	3	(D)	(D)	(D)
2013-14	WINTER	Montana	28	22	1	5	28,378	12.9 [10.1 - 16.2]	24.7 [13.2 - 36.2]	75.0	0.4	21	107	23.6 [14.6 - 34.6]	29 [34.6 - 7.6]	7	28,271	12.9 [7.4 - 20.1]	11.9 [9.5 - 3.6]
2013-14	WINTER	Nebraska	15	12	1	2	79,237	17.9 [16.2 - 19.6]	57.7 [39.3 - 76.1]	80.0	0.1	12	97	45.5 [32.4 - 59]	61.8 [35.9 - 10.4]	3	(D)	(D)	(D)
2013-14	WINTER	Nevada	12	10	2	0	625	32.2 [23.7 - 41.6]	38.8 [19.3 - 58.2]	83.3	12.0	10	75	46.2 [24.7 - 68.6]	39.7 [37.8 - 12]	2	(D)	(D)	(D)
2013-14	WINTER	New Hampshire	74	73	1	0	529	53.1 [46.4 - 59.7]	56.8 [48 - 65.6]	95.9	62.4	71	330	56.9 [48.4 - 65.1]	57.5 [39.1 - 4.6]	3	(D)	(D)	(D)
2013-14	WINTER	New Jersey	197	190	5	2	14,714	22.7 [21.1 - 24.4]	37.8 [32.8 - 42.9]	95.9	9.0	189	1,329	37.1 [33 - 41.4]	37.2 [36.2 - 2.6]	8	13,385	21.7 [16.1 - 28.1]	51.9 [31.3 - 11.1]
2013-14	WINTER	New Mexico	23	23	0	0	116	24.4 [14.2 - 37]	23.1 [9.6 - 36.6]	100.0	100.0	23	116	24.4 [14.2 - 37]	23.1 [33 - 6.9]	0			
2013-14	WINTER	New York	211	192	14	5	20,607	30.4 [28.2 - 32.6]	47.9 [43.2 - 52.7]	94.3	18.3	199	3,774	50.6 [46.6 - 54.6]	48.2 [35.6 - 2.5]	12	16,833	27.3 [21.4 - 33.8]	43.2 [29.2 - 8.4]
2013-14	WINTER	North Carolina	292	285	5	2	71,168	18 [17.2 - 18.7]	34.5 [30.4 - 38.6]	94.5	2.9	276	2,058	35.5 [31.9 - 39.2]	35.5 [36.2 - 2.2]	16	69,110	17.4 [16.4 - 18.4]	17.5 [20.3 - 5.1]
2013-14	WINTER	North Dakota	31	2	3	26	150,882	24.7 [19.5 - 30.4]	21.3 [15.9 - 26.6]	3.2	0.0	1	(D)	(D)	(D)	30	150,880	24.7 [19.4 - 30.5]	22 [14.8 - 2.7]
2013-14	WINTER	Ohio	486	479	6	1	13,724	31.5 [29.8 - 33.1]	54.9 [51.5 - 58.3]	97.9	25.2	476	3,461	57.9 [55.2 - 60.6]	54.9 [38 - 1.7]	10	10,263	25.4 [22.8 - 28.2]	52.8 [21.9 - 6.9]
2013-14	WINTER	Oklahoma	34	32	0	2	6,551	39.8 [37.1 - 42.5]	28.9 [17.7 - 40.2]	91.2	3.7	31	240	16.8 [9.1 - 27]	26.6 [33.7 - 6.1]	3	(D)	(D)	(D)
2013-14	WINTER	Oregon	222	207	3	12	50,691	17 [15.3 - 18.8]	38.1 [33.1 - 43.2]	92.8	10.1	206	5,104	44.3 [42.4 - 46.2]	40 [38.9 - 2.7]	16	45,587	14.2 [10 - 19.2]	13.9 [13.1 - 3.3]
2013-14	WINTER	Pennsylvania	1,081	1,060	18	3	23,126	31.5 [30.4 - 32.6]	50 [47.7 - 52.3]	98.1	31.0	1,061	7,178	43.9 [42.1 - 45.7]	50 [39 - 1.2]	20	15,948	27.6 [22.9 - 32.7]	50.3 [30.1 - 6.7]
2013-14	WINTER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2013-14	WINTER	Rhode Island	24	23	1	0	205	32.9 [23.7 - 43]	34.3 [19.7 - 48.9]	70.8	38.0	17	78	30.8 [15.3 - 49.9]	37.2 [42.1 - 10.2]	7	127	34.1 [26.5 - 42.4]	27.3 [17.2 - 6.5]
2013-14	WINTER	South Carolina	155	149	5	1	2,313	28.4 [25.2 - 31.8]	29.5 [24.2 - 34.7]	96.1	57.6	149	1,332	29.2 [25 - 33.5]	29.5 [33.7 - 2.8]	6	981	27.5 [19.5 - 36.6]	28.4 [26.5 - 10.8]
2013-14	WINTER	South Dakota	17	11	1	5	80,228	19.8 [14.5 - 26]	43.3 [27.3 - 59.3]	52.9	0.0	9	35	36.1 [20.9 - 53.5]	47 [38.3 - 12.8]	8	80,193	19.8 [12.1 - 29.5]	39.2 [29.5 - 10.4]
2013-14	WINTER	Tennessee	102	97	5	0	1,066	20.4 [16 - 25.4]	32 [25.3 - 38.7]	95.1	81.6	97	870	29.4 [24.4 - 34.8]	32.2 [34.5 - 3.5]	5	196	5.7 [0.5 - 20.6]	29.2 [40.2 - 18]
2013-14	WINTER	Texas	82	59	7	16	125,685	18.9 [16.9 - 21.1]	22.7 [17.1 - 28.2]	76.8	2.0	63	2,456	45.6 [42 - 49.1]	22.4 [26 - 3.3]	19	123,229	18 [14.5 - 22]	23.3 [24.3 - 5.6]
2013-14	WINTER	Utah	61	52	5	4	9,250	16.3 [13.6 - 19.3]	38.7 [29.7 - 47.7]	83.6	2.6	51	241	34.8 [26.2 - 44.1]	40.4 [37.4 - 5.2]	10	9,009	15.7 [10.2 - 22.5]	30 [26.7 - 8.5]
2013-14	WINTER	Vermont	104	101	2	1	1,696	42.4 [39 - 45.8]	47.2 [39.6 - 54.7]	96.2	95.9	100	1,627	42.2 [38.7 - 45.7]	46.8 [39.6 - 4]	4	(D)	(D)	(D)
2013-14	WINTER	Virginia	796	781	14	1	15,726	27 [26 - 28]	36 [33.4 - 38.5]	98.2	35.1	782	5,514	33 [31.1 - 34.9]	36.1 [36.3 - 1.3]	14	10,212	24.8 [23.1 - 26.5]	29 [35.2 - 9.4]
2013-14	WINTER	Washington	161	141	9	11	74,378	25.9 [22.7 - 29.2]	37.9 [32.3 - 43.5]	90.1	1.7	145	1,247	36 [31.4 - 40.8]	40.6 [36.6 - 3]	16	73,131	25.7 [16.2 - 37.1]	13.3 [14.6 - 3.6]
2013-14	WINTER	West Virginia	75	70	5	0	1,125	41.8 [35 - 48.8]	42 [34 - 49.9]	92.0	67.9	69	764	51.9 [44.6 - 59.1]	43.1 [35.8 - 4.3]	6	361	19.7 [9 - 34.4]	29.2 [23.1 - 9.4]
2013-14	WINTER	Wisconsin	183	159	13	11	36,244	19.9 [17.6 - 22.4]	57.7 [52.2 - 63.1]	89.1	5.9	163	2,151	58.3 [54 - 62.5]	61.3 [36.8 - 2.9]	20	34,093	17.9 [12.6 - 24]	28.5 [32.2 - 7.2]
2013-14	WINTER	Wyoming	11	6	1	4	20,661	12.1 [9.6 - 14.8]	38.2 [20.2 - 56.1]	36.4	0.1	4	(D)	(D)	(D)	7	20,641	12 [9.1 - 15.5]	32.2 [28.8 - 10.9]
2013-14	WINTER	Other	0																
2013-14	WINTER	MultiStateOperation	209	85	42	82	386,373	20.7 [18.8 - 22.7]	30.6 [26.9 - 34.3]	0.0	0.0	209	386,373	20.7 [18.8 - 22.7]	30.6 [27.2 - 1.9]	209	386,373	20.7 [18.8 - 22.7]	30.6 [27.2 - 1.9]
2014-15	WINTER	Alabama	31	30	1	0	354	34.7 [26.2 - 44]	29.7 [20.7 - 38.7]	96.8	97.2	30	344	35.3 [26.6 - 44.7]	30.4 [25.7 - 4.7]	1	(D)	(D)	(D)
2014-15	WINTER	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2014-15	WINTER	Arizona	10	8	1	1	1,032	52.6 [43 - 62.1]	34.5 [11.4 - 57.7]	90.0	36.0	9	372	35.8 [27.4 - 44.8]	31.5 [38.3 - 12.8]	1	(D)	(D)	(D)
2014-15	WINTER	Arkansas	103	99	3	1	2,072	20.2 [16.2 - 24.5]	31.2 [24.9 - 37.5]	94.2	80.6	97	1,669	22.1 [17.8 - 27]	32.2 [33.4 - 3.4]	6	403	12.4 [6.4 - 20.7]	16 [10.9 - 4.4]
2014-15	WINTER	California	208	127	24	57	320,003	20 [18 - 22]	27.4 [23.6 - 31.1]	63.9	10.8	133	34,429	18.7 [15.8 - 21.7]	29.8 [31.5 - 2.7]	75	285,574	20.2 [17 - 23.5]	23.1 [19.2 - 2.2]
2014-15	WINTER	Colorado	214	211	2	1	63,126	16.8 [16 - 17.7]	48.1 [42.8 - 53.4]	97.7	1.6	209	989	44.6 [40.3 - 48.9]	48.1 [40.1 - 2.8]	5	62,137	16.4 [13.1 - 20]	49.3 [28.1 - 12.6]
2014-15	WINTER	Connecticut	71	68	3	0	701	49.2 [42.4 - 55.9]	55.4 [46.8 - 64]	94.4	59.5	67	417	51.2 [43.7 - 58.6]	55.6 [37.7 - 4.6]	4	(D)	(D)	(D)

SurveyYear	Season	State	All operations in the State N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2014-15	WINTER	District of Columbia	5	4	1	0	265	41.1 [32.6 - 50]	88 [64.3 - 111.6]	80.0	2.3	4	(D)	(D)	(D)	1	(D)	(D)	(D)
2014-15	WINTER	Delaware	20	17	1	2	18,426	40.5 [38.2 - 42.8]	36 [22.4 - 49.5]	70.0	0.3	14	62	37.9 [24.7 - 52.4]	32.6 [34.1 - 9.1]	6	18,364	40.5 [36.2 - 44.9]	43.9 [22.5 - 9.2]
2014-15	WINTER	Florida	111	89	16	6	27,403	35.8 [33.4 - 38.1]	24.8 [19.3 - 30.3]	87.4	8.3	97	2,277	36.6 [31.4 - 41.9]	24.6 [30.9 - 3.1]	14	25,126	35.7 [30.1 - 41.5]	26.4 [21.9 - 5.9]
2014-15	WINTER	Georgia	81	71	8	2	3,977	23.9 [19.7 - 28.5]	42 [34.3 - 49.7]	86.4	40.7	70	1,617	31.9 [25.4 - 38.9]	43.3 [34.8 - 4.2]	11	2,360	19.6 [13.2 - 27.3]	33.6 [38.2 - 11.5]
2014-15	WINTER	Hawaii	34	24	6	4	10,165	8.9 [4.7 - 14.9]	8.8 [4.2 - 13.5]	97.1	99.1	33	10,075	8.9 [4.6 - 15]	8.8 [14 - 2.4]	1	(D)	(D)	(D)
2014-15	WINTER	Idaho	62	48	1	13	74,921	15.6 [13.2 - 18.2]	30.1 [22.2 - 37.9]	77.4	0.3	48	230	29.1 [21.7 - 37.2]	33.8 [34.5 - 5]	14	74,691	15.5 [10.7 - 21.3]	17.2 [11.8 - 3.1]
2014-15	WINTER	Illinois	137	136	1	0	1,133	51.9 [47 - 56.8]	57.7 [51.4 - 63.9]	97.8	76.0	134	861	53.7 [48.1 - 59.3]	57.9 [37.9 - 3.3]	3	(D)	(D)	(D)
2014-15	WINTER	Indiana	138	136	1	1	3,770	16.9 [13.4 - 20.7]	43.8 [37.9 - 49.8]	97.1	25.2	134	951	44.8 [40 - 49.6]	43.7 [35.5 - 3.1]	4	(D)	(D)	(D)
2014-15	WINTER	Iowa	47	43	4	0	947	47.4 [39 - 55.8]	53.1 [45.2 - 60.9]	93.6	68.7	44	651	59.5 [51.5 - 67.3]	54.1 [27.1 - 4.1]	3	(D)	(D)	(D)
2014-15	WINTER	Kansas	44	42	2	0	871	27.2 [20.9 - 34.3]	37.4 [26.9 - 47.9]	97.7	85.4	43	744	33.8 [27.7 - 40.3]	38.2 [35.6 - 5.4]	1	(D)	(D)	(D)
2014-15	WINTER	Kentucky	70	68	2	0	674	37.7 [31.7 - 44]	42 [33.7 - 50.4]	97.1	74.5	68	502	42.8 [36 - 49.9]	42.4 [36.2 - 4.4]	2	(D)	(D)	(D)
2014-15	WINTER	Louisiana	22	20	1	1	3,617	33.3 [30.5 - 36.1]	30.8 [19.6 - 42]	86.4	12.6	19	454	23.4 [17.7 - 29.8]	28.5 [27.1 - 6.2]	3	(D)	(D)	(D)
2014-15	WINTER	Maine	126	122	2	2	18,910	39.9 [38.9 - 40.8]	47.8 [41.2 - 54.4]	96.0	4.0	121	753	37 [31.4 - 42.8]	47.9 [38.1 - 3.5]	5	18,157	39.9 [38.3 - 41.6]	45.7 [27.5 - 12.3]
2014-15	WINTER	Maryland	158	153	4	1	10,577	41.4 [39.9 - 42.9]	46.6 [41.3 - 51.9]	93.7	8.6	148	913	44.2 [40 - 48.4]	45.8 [33.9 - 2.8]	10	9,664	41.2 [36.2 - 46.3]	58.9 [33.8 - 10.7]
2014-15	WINTER	Massachusetts	195	191	4	0	1,477	42.9 [38.2 - 47.7]	51.6 [46.3 - 56.9]	97.4	75.9	190	1,121	49.7 [44.8 - 54.6]	51.5 [37.8 - 2.7]	5	356	20.9 [7.3 - 41.6]	52.4 [41.4 - 18.5]
2014-15	WINTER	Michigan	284	274	9	1	9,594	24.4 [21.9 - 27.1]	48.7 [44.5 - 53]	98.2	90.2	279	8,654	21.6 [19.4 - 24]	48.9 [36.4 - 2.2]	5	940	53.2 [28.2 - 77.2]	41.8 [39.3 - 17.6]
2014-15	WINTER	Minnesota	109	96	5	8	77,361	19.4 [17.1 - 21.9]	59.5 [52.8 - 66.2]	85.3	0.9	93	684	59.5 [53.5 - 65.3]	64.1 [35 - 3.6]	16	76,677	19.1 [13.5 - 25.7]	32.9 [29.4 - 7.4]
2014-15	WINTER	Mississippi	12	9	1	2	6,123	19.9 [12.6 - 28.9]	29.3 [13.2 - 45.3]	83.3	5.3	10	323	44.4 [33 - 56.3]	32.2 [29.6 - 9.4]	2	(D)	(D)	(D)
2014-15	WINTER	Missouri	114	107	7	0	1,823	25.1 [20.8 - 29.9]	33 [27.3 - 38.7]	97.4	96.4	111	1,758	25.3 [20.8 - 30.2]	33.4 [31.2 - 3]	3	(D)	(D)	(D)
2014-15	WINTER	Montana	31	22	1	8	30,059	27.9 [20.3 - 36.4]	39.7 [27.5 - 51.9]	74.2	5.0	23	1,491	22.7 [19.2 - 26.4]	44.2 [35.5 - 7.4]	8	28,568	28.1 [13.6 - 46.8]	26.9 [30.4 - 10.7]
2014-15	WINTER	Nebraska	15	13	0	2	72,610	17.3 [15.7 - 18.9]	52.5 [34.1 - 70.8]	80.0	0.1	12	98	37.8 [22 - 55.5]	56 [37.7 - 10.9]	3	(D)	(D)	(D)
2014-15	WINTER	Nevada	8	6	1	1	1,147	5.2 [0.1 - 26.9]	45.5 [15.9 - 75.1]	62.5	2.5	5	29	48.3 [16.2 - 81.4]	61.3 [42.5 - 19]	3	(D)	(D)	(D)
2014-15	WINTER	New Hampshire	59	57	2	0	651	36.3 [30.7 - 42.1]	50.9 [40.9 - 60.9]	93.2	65.7	55	428	39.3 [32.8 - 46.1]	51 [39.2 - 5.3]	4	(D)	(D)	(D)
2014-15	WINTER	New Jersey	112	108	4	0	1,295	36.5 [32 - 41.1]	37.4 [30.9 - 43.9]	94.6	80.5	106	1,042	28.9 [25.2 - 32.9]	37 [35.4 - 3.4]	6	253	67.7 [54.3 - 79.4]	45.9 [30.8 - 12.6]
2014-15	WINTER	New Mexico	24	23	0	1	1,926	42.9 [39.7 - 46.1]	30.6 [16.3 - 45]	95.8	6.5	23	126	26.9 [19 - 35.8]	30 [36.6 - 7.6]	1	(D)	(D)	(D)
2014-15	WINTER	New York	182	166	10	6	26,818	35.4 [33.8 - 37]	40 [35.1 - 44.9]	95.1	13.6	173	3,648	28.3 [25.4 - 31.4]	40 [33.8 - 2.6]	9	23,170	36.1 [29.8 - 42.8]	40.5 [32.8 - 10.9]
2014-15	WINTER	North Carolina	301	297	4	0	2,300	34.4 [31.3 - 37.7]	35.7 [32 - 39.5]	97.7	97.3	294	2,239	34.3 [31.1 - 37.5]	35.5 [33.4 - 1.9]	7	61	41.9 [27 - 58]	43.4 [33 - 12.5]
2014-15	WINTER	North Dakota	34	6	2	26	199,777	18.2 [15.1 - 21.6]	25.2 [17.6 - 32.8]	11.8	0.0	4	(D)	(D)	(D)	30	199,763	18.2 [14.9 - 21.8]	23.2 [17.3 - 3.2]
2014-15	WINTER	Ohio	345	337	8	0	3,387	50.1 [46.5 - 53.7]	49.4 [45.4 - 53.5]	98.0	86.1	338	2,916	46.4 [42.8 - 50.1]	49.3 [38.4 - 2.1]	7	471	74.9 [55.9 - 89.1]	56.4 [32.7 - 12.4]
2014-15	WINTER	Oklahoma	40	36	1	3	5,880	36.5 [32 - 41.2]	37.9 [27.9 - 48]	90.0	5.4	36	318	43 [33 - 53.4]	39 [34 - 5.7]	4	(D)	(D)	(D)
2014-15	WINTER	Oregon	177	169	1	7	38,036	14.7 [13.4 - 16]	28.9 [24.1 - 33.6]	94.9	33.9	168	12,904	14 [12.5 - 15.7]	29.4 [32.6 - 2.5]	9	25,132	15 [10 - 21.1]	18.3 [22.8 - 7.6]
2014-15	WINTER	Pennsylvania	860	841	17	2	24,766	42.6 [41.7 - 43.6]	53.2 [50.7 - 55.6]	98.3	24.5	845	6,077	51.6 [49.5 - 53.6]	53.2 [36.7 - 1.3]	15	18,689	40.8 [37.7 - 44]	51.2 [32.7 - 8.4]
2014-15	WINTER	Puerto Rico	0																
2014-15	WINTER	Rhode Island	26	24	2	0	397	47.4 [36.5 - 58.4]	51.1 [35.9 - 66.3]	73.1	24.4	19	97	46.4 [32.2 - 60.9]	47.5 [40.4 - 9.3]	7	300	47.7 [27.4 - 68.6]	60.9 [38.7 - 14.6]
2014-15	WINTER	South Carolina	79	75	3	1	2,061	22.3 [18.6 - 26.3]	31.9 [25 - 38.8]	89.9	27.2	71	560	31.1 [25.4 - 37.1]	32.9 [31.6 - 3.8]	8	1,501	19.6 [11.2 - 30.4]	22.7 [28.2 - 10]
2014-15	WINTER	South Dakota	16	9	0	7	76,136	16.3 [12.5 - 20.7]	32.7 [18.1 - 47.2]	50.0	0.0	8	27	41.4 [24.1 - 60.3]	32.2 [34.9 - 12.3]	8	76,109	16.3 [11 - 22.8]	33.1 [25.9 - 9.2]
2014-15	WINTER	Tennessee	82	76	6	0	1,223	21.9 [17.2 - 27.2]	39.3 [31.9 - 46.7]	96.3	90.2	79	1,103	25.2 [20.3 - 30.5]	39.5 [34.4 - 3.9]	3	(D)	(D)	(D)
2014-15	WINTER	Texas	157	139	3	15	109,746	20.9 [19.1 - 22.8]	21.3 [17 - 25.5]	87.3	2.6	137	2,850	38.9 [36.4 - 41.4]	20.4 [27.8 - 2.4]	20	106,896	20.1 [15.5 - 25.3]	26.8 [21 - 4.7]
2014-15	WINTER	Utah	47	40	3	4	16,677	17.3 [15 - 19.8]	43.5 [34.4 - 52.6]	85.1	1.3	40	209	49.8 [40.4 - 59.1]	46.8 [33.2 - 5.3]	7	16,468	16.9 [12 - 22.7]	24.8 [11.9 - 4.5]
2014-15	WINTER	Vermont	67	63	4	0	707	29.1 [24 - 34.6]	32.9 [24.2 - 41.7]	94.0	58.7	63	415	26.4 [20 - 33.6]	33 [37.3 - 4.7]	4	(D)	(D)	(D)
2014-15	WINTER	Virginia	722	709	13	0	5,365	36.3 [34.3 - 38.4]	42.9 [40.2 - 45.6]	98.8	98.8	713	5,300	36.3 [34.2 - 38.4]	43 [37.5 - 1.4]	9	65	37.3 [26.8 - 48.7]	38.6 [20 - 6.7]
2014-15	WINTER	Washington	158	145	3	10	107,980	20.4 [18.3 - 22.7]	45.6 [39.8 - 51.4]	93.0	1.0	147	1,057	34.1 [29.5 - 38.8]	46.2 [37.5 - 3.1]	11	106,923	20.3 [12.6 - 29.8]	36.9 [32.5 - 9.8]
2014-15	WINTER	West Virginia	54	52	2	0	829	56.2 [47.6 - 64.5]	35.1 [26.7 - 43.6]	87.0	46.8	47	388	33.9 [26.3 - 40.9]	32 [31.8 - 4.6]	7	441	76.1 [56.8 - 90]	55.9 [24.5 - 9.2]
2014-15	WINTER	Wisconsin	161	147	11	3	21,404	39.6 [38.3 - 41]	58.1 [52.4 - 63.7]	94.4	10.4	152	2,229	42.9 [38.2 - 47.6]	59.3 [36.8 - 3]	9	19,175	39.4 [36.6 - 42.2]	37.5 [25.5 - 8.5]
2014-15	WINTER	Wyoming	12	8	0	4	14,282	17.3 [8.8 - 28.8]	41.5 [21.8 - 61.2]	66.7	0.2	8	32	32.4 [15.1 - 53.7]	50.9 [36.5 - 12.9]	4	(D)	(D)	(D)
2014-15	WINTER	Other	0																
2014-15	WINTER	MultiStateOperation	164	73	34	57	297,803	20.9 [18.7 - 23.3]	34.1 [29.7 - 38.4]	0.0	0.0	164	297,803	20.9 [18.7 - 23.3]	34.1 [28.5 - 2.2]	164	297,803	20.9 [18.7 - 23.3]	34.1 [28.5 - 2.2]
2015-16	WINTER	Alabama	47	47	0	0	463	20.1 [13.4 - 28.2]	18.3 [10.7 - 25.9]	97.9	97.4	46	451	19.1 [12.4 - 27.3]	17.6 [26.5 - 3.9]	1	(D)	(D)	(D)
2015-16	WINTER	Alaska	5	5	0	0	19	72 [42.9 - 91.9]	79.1 [54 - 104.2]	100.0	100.0	5	19	72 [42.9 - 91.9]	79.1 [28.7 - 12.8]	0			
2015-16	WINTER	Arizona	8	8	0	0	43	29.5 [10.6 - 55.4]	17.8 [-4 - 39.5]	100.0	100.0	8	43	29.5 [10.6 - 55.4]	17.8 [31.4 - 11.1]	0			
2015-16	WINTER	Arkansas	43	42	0	1	1,216	15.3 [11.8 - 19.4]	22.7 [14.3 - 31.1]	90.7	29.1	39	354	19.6 [14.6 - 25.3]	22.3 [28.7 - 4.6]	4	(D)	(D)	(D)
2015-16	WINTER	California	204	122	16	66	330,890	26.5 [24.1 - 28.9]	36.3 [31.8 - 40.7]	63.7	6.6	130	21,897	24.9 [23.3 - 26.7]	42.2 [36.5 - 3.2]	74	308,993	26.6 [22.6 - 30.7]	25.8 [20 - 2.3]
2015-16	WINTER	Colorado	185	181	3	1	3,253	20.7 [18.3 - 23.3]	39.6 [34.2 - 45]	97.3	27.6	180	897	34.2 [30.1 - 38.5]	40.3 [37.9 - 2.8]	5	2,356	15.4 [12.7 - 18.6]	14.3 [11.9 - 5.3]
2015-16	WINTER	Connecticut	75	73	2	0	795	39.5 [34.2 - 44.9]	42.8 [34.6 - 51]	94.7	96.6	71	768	39.7 [34.5 - 45]	42.6 [36 - 4.3]	4	(D)	(D)	(D)
2015-16	WINTER	District of Columbia	8	7	1	0	117	22.2 [11.7 - 35.9]	52.8 [23.5 - 82.1]	75.0	12.8	6	15	53.3 [26.8 - 78.6]	65.5 [41.5 - 16.9]	2	(D)	(D)	(D)
2015-16	WINTER	Delaware	24	22	0	2	10,636	43.6 [41.4 - 45.9]	38.4 [24.4 - 52.5]	79.2	0.9	19	92	38.5 [26 - 52.2]	38.4 [38.3 - 8.8]	5	10,544	43.7 [38.8 - 48.6]	38.5 [22.6 - 10.1]
2015-16	WINTER	Florida	61	51	4	6	26,647	41.5 [38.6 - 44.4]	27 [19.6 - 34.4]	90.2	18.6	55	4,947	34.1 [30.9 - 37.5]	26.3 [30.5 - 4.1]	6	21,700	42.6 [33.3 - 52.4]	33.5 [19.9 - 8.1]
2015-16	WINTER	Georgia	71	67	3	1	1,424	19.4 [15.8 - 23.4]	25.3 [19.6 - 31]	93.0	40.4	66	576	29.1 [23.4 - 35.3]	25.6 [25.1 - 3.1]	5	848	15.4 [8.5 - 24.6]	21.9 [20.7 - 9.3]
2015-16	WINTER	Hawaii	51	47	2	2	5,350	2.4 [1.2 - 4.2]	11.2 [5.5 - 16.8]	98.0	99.9	50	5,344	2.4 [1.2 - 4.2]	11.4 [20.8 - 2.9]	1	(D)	(D)	(D)
2015-16	WINTER	Idaho	53	35	2	16	91,018	25.2 [21.7 - 28.9]	43.2 [34 - 52.4]	67.9	1.6	36	1,430	18.6 [12.1 - 26.5]	51.5 [37.7 - 6.3]	17	89,588	25.3 [19.2 - 32.1]	25.6 [14.2 - 3.4]
2015-16	WINTER	Illinois	155	153	2	0	1,212	37.3 [32.4 - 42.4]	45 [39.1 - 50.8]	96.8	96.2	150	1,166	38 [33 - 43.3]	46 [37.2 - 3]	5	46	20 [8.7 - 34]	13.3 [14.7 - 6.6]
2015-16	WINTER	Indiana	198	193	5	0	1,738	26.8 [22.8 - 31.1]	34.8 [29.7 - 40]	98.5	98.7	195	1,715	27 [22.9 - 31.3]	35.2 [37.2 - 2.7]	3	(D)	(D)	(D)
2015-16	WINTER	Iowa	55	52	3	0	917	38.3 [33 - 43.8]	34.7 [26.1 - 43.3]	96.4	64.8	53	594	32.7 [26.6 - 39.1]	35.1 [32.8 - 4.5]	2	(D)	(D)	(D)
2015-16	WINTER	Kansas	36	33	2	1	4,000	45.9 [43 - 48.9]	27.5 [18 - 37]	94.4	9.9	34	397	54 [41.7 - 65.9]	26.8 [29.8 - 5.1]	2	(D)	(D)	(D)
2015-16	WINTER	Kentucky	81	78	3	0	726	26.9 [21.8 - 32.6]	33.2 [25.9 - 40.5]	97.5	97.8	79	710	26.9 [21.6 - 32.6]	33.1 [33.8 - 3.8]	2	(D)	(D)	(D)
2015-16	WINTER	Louisiana	24	22	2	0	646	14 [7.4 - 22.9]	19.6 [8.2 - 30.9]	100.0	100.0	24	646	14 [7.4 - 22.9]	19.6 [28.3 - 5.8]	0			
2015-16	WINTER	Maine	112	108	2	2	29,967	18.2 [14.4 - 22.4]	37.6 [30.2 - 44.9]	97.3	2.5	109	761	27.7 [22.5 - 33.3]	37.7 [39.8 - 3.8]	3	(D)	(D)	(D)
2015-16	WINTER	Maryland	154	144	6	4	14,905	40 [37.7 - 42.3]	40.3 [34.5 - 46.1]	94.2	12.5	145	1,868	47.6 [43.1 - 52]	41.3 [37.1 - 3.1]	9	13,037	39.3 [30.8 - 48.2]	24.3 [22.1 - 7.4]
2015-16	WINTER	Massachusetts	153	152	0	1	1,272	48.6 [44.1 - 53.2]	43.7 [37.5 - 49.9]	96.1	96.6	147	1,229	49.4 [44.8 - 54]	44.2 [39.6 - 3.3]	6	43	25.6 [9.6 - 48.1]	31.9 [27.1 - 11.1]
2015-16	WINTER	Michigan	256	245	9	2	4,772	28.7 [25.8 - 31.6]	51.8 [47.2 - 56.4]	98.4	50.0	252	2,387	40.8 [37 - 44.6]	52.3 [37.6 - 2.4]	4	(D)	(D)	(D)
2015-16	WINTER	Minnesota	170	153	10	7	25,014	35.4 [33.2 - 37.6]	49.6 [43.4 - 55.7]	90.6	9.4	154	2,363	40.9 [37.1 - 44.9]	52.1 [41.2 - 3.3]	16	22,651	35.1 [28.5 - 42]	24.9 [27.3 - 6.8]
2015-16	WINTER	Mississippi	15	13	0	2	5,124	60.1 [49.6 - 70]	29.8 [16.7 - 42.9]	66.7	1.6	10	81	17.4 [7 - 32.4]	24.1 [22.4 - 7.1]	5	5,043	60.4 [41.1 - 77.7]	41.1 [31.1 - 13.9]
2015-16	WINTER	Missouri	138	137	1	0	1,033	23.2 [19.7 - 27]	26.8 [21.5 - 32]	97.1	92.3	134	953	22.6 [19 - 26.4]	26.8 [31.8 - 2.7]	4	(D)	(D)	(D)
2015-16	WINTER	Montana	18	8	1	9	39,811	12.1 [8 - 17]	25.7 [11.5 - 39.9]	38.9	0.2	7	95	20 [4.3 - 47.3]	38.9 [44.1 - 16.7]	11	39,716	12 [7 - 18.6]	17.3 [15.5 - 4.7]
2015-16	WINTER	Nebraska	18	14	1	3	26,792	27.4 [22.8 - 32.4]	38 [22.4 - 53.6]	77.8	0.9	14	252	27 [17.4 - 38.2]	37.1 [36.3 - 9.7]	4	(D)	(D)	(D)
2015-16	WINTER	Nevada	9	8	0	1	2,261	19 [15 - 23.6]	39 [17.8 - 60.3]	77.8	1.2	7	28	41.9 [19.9 - 66.4]	39.8 [36 - 13.6]	2	(D)	(D)	(D)
2015-16	WINTER	New Hampshire	64	64	0	0	307	29.5 [22.6 - 37.1]	35.9 [26.8 - 45.1]	92.2	87.0	59	267	27.5 [20.2 - 35.7]	35.1 [38.6 - 5]	5	40	42.9 [27.4 - 59.3]	45.7 [18.3 - 8.2]
2015-16	WINTER	New Jersey	129	122	5	2	8,000	46.6 [43.4 - 50]	26.3 [20.9 - 31.8]	90.7	14.7	117	1,173	18.6 [14.6 - 23]	25.8 [32 - 3]	12	6,827	51.5 [43.7 - 59.2]	30.9 [28 - 8.1]
2015-16	WINTER	New Mexico	19	18	1	0	199	37.4 [24.2 - 51.9]	36.4 [23 - 49.9]	84.2	67.8	16	135	51.9 [38.5 - 65]	42.8 [28.1 - 7]	3	(D)	(D)	(D)
2015-16	WINTER	New York	189	176	5	8	24,016	33.3 [30.5 - 36.1]	33.9 [28.8 - 39]	94.2	12.8	178	3,080	40.3 [34.6 - 46.1]	33.9 [36 - 2.7]	11	20,936	32.4 [23.5 - 42.3]	33.1 [32 - 9.6]
2015-16	WINTER	North Carolina	271	266	3	2	9,514	31.3 [29.7 - 33]	31.3 [27.3 - 35.3]	97.4	21.6	264	2,053	26 [22.9 - 29.4]	31.6 [33.8 - 2.1]	7	7,461	33 [30 - 36]	20.9 [25.3 - 9.6]
2015-16	WINTER	North Dakota	31	8	0	23	171,301	26.4 [20.5 - 32.8]	39.2 [28.8 - 49.5]	19.4	0.0	6	28	60.7 [32 - 85]	55.6 [46.7 - 19.1]	25	171,273	26.4 [19.9 - 33.6]	35.2 [23.1 - 4.6]
2015-16	WINTER	Ohio	296	289	7	0	2,933	31.6 [28.6 - 34.8]	32.9 [28.7 - 37]	97.0	96.6	287	2,833	32.4 [29.2 - 35.6]	33 [36.4 - 2.1]	9	100	15.7 [5.4 - 32.1]	28.6 [31.9 - 10.6]
2015-16	WINTER	Oklahoma	46	43	2	1	4,352	28.6 [22.7 - 34.9]	30.5 [19.8 - 41.1]	97.8	15.5	45	676	56.9 [44.6 - 68.7]	30.6 [37.4 - 5.6]	1	(D)	(D)	(D)
2015-16	WINTER	Oregon	159	148	1	10	31,555	22.2 [19.7 - 24.7]	34.4 [28.9 - 39.9]	91.8	22.2	146	7,012	34 [32.5 - 35.5]	35.9 [36.3 - 3]	13	24,543	19.2 [11.4 - 29.1]	17.6 [16.5 - 4.6]
2015-16	WINTER	Pennsylvania	777	767	9	1	15,198	41.3 [40.2 - 42.4]	43.5 [40.9 - 46.2]	98.7	31.9	767	4,844	38.2 [36 - 40.4]	43.8 [37.9 - 1.4]	10	10,354	42.1 [38.6 - 45.7]	24.8 [24.3 - 7.7]
2015-16	WINTER	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2015-16	WINTER	Rhode Island	24	24	0	0	108	23.1 [13.7 - 34.9]	26.9 [12.6 - 41.1]	83.3	75.0	20	81	23.5 [12.6 - 37.3]	27.5 [37 - 8.3]	4	(D)	(D)	(D)
2015-16	WINTER	South Carolina	107	103	3	1	1,772	26.4 [23.8 - 29.1]	25.7 [20 - 31.3]	97.2	39.5	104	700	25.4 [21.1 - 30]	25.3 [30.3 - 3]	3	(D)	(D)	(D)
2015-16	WINTER	South Dakota	16	8	0	8	63,677	35.5 [28.8 - 42.8]	44.8 [27.5 - 62.1]	43.8	0.1	7	66	25.8 [9.4 - 48.8]	56.3 [45.2 - 17.1]	9	63,611	35.6 [26.4 - 45.5]	35.9 [24.5 - 8.2]
2015-16	WINTER	Tennessee	113	106	7	0	1,495	24.9 [20.7 - 29.3]	25.1 [19.7 - 30.4]	97.3	95.3	110	1,425	24.7 [20.4 - 29.3]	25.2 [29.5 - 2.8]	3	(D)	(D)	(D)
2015-16	WINTER	Texas	99	77	4	18	107,590	35.1 [31.9 - 38.3]	18.2 [13.3 - 23]	78.8	1.3	78	1,436	30.2 [26.3 - 34.3]	15.5 [24.6 - 2.8]	21	106,154	35.1 [28.2 - 42.4]	28.1 [22.6 - 4.9]
2015-16	WINTER	Utah	46	39	4	3	9,891	34.7 [31.3 - 38.2]	55.9 [45.8 - 66]	84.8	4.1	39	410	43.4 [34.6 - 52.4]	57.2 [36.6 - 5.9]	7	9,481	34.3 [26.3 - 42.9]	48.6 [25.9 - 9.8]
2015-16	WINTER	Vermont	58	54	2	2	2,242	10 [6.3 - 14.7]	31.5 [22.7 - 40.2]	89.7	47.7	52	1,070	15.9 [11.3 - 21.5]	31.2 [34.6 - 4.8]	6	1,172	4.5 [0.2 - 20.9]	34 [32.5 - 13.3]
2015-16	WINTER	Virginia	692	683	9	0	4,019	32.3 [30.1 - 34.5]	38.7 [35.9 - 41.5]	98.3	91.8	680	3,690	33.6 [31.4 - 35.9]	39 [37.9 - 1.5]	12	329	17.4 [10.4 - 26.2]	23.8 [25.8 - 7.4]
2015-16	WINTER	Washington	136	127	4	5	28,783	18 [16.2 - 19.9]	48.7 [42.7 - 54.7]	94.1	4.0	128	1,137	48.9 [43.9 - 53.8]	50.6 [35.6 - 3.1]	8	27,646	16.8 [11.9 - 22.7]	17.7 [15.2 - 5.4]
2015-16	WINTER	West Virginia	63	59	3	1	1,270	45.2 [38.3 - 52.2]	34.4 [26.3 - 42.6]	92.1	42.8	58	544	35.7 [29.6 - 42.2]	35.2 [33.4 - 4.4]	5	726	52.1 [25.7 - 77.6]	25 [30.9 - 13.8]
2015-16	WINTER	Wisconsin	165	156	6	3	19,808	35.7 [33.8 - 37.6]	47.1 [41.5 - 52.7]	94.5	19.9	156	3,947	25.2 [21.6 - 29.2]	48.7 [36.8 - 2.9]	9	15,861	37.3 [31.9 - 42.8]	19.1 [18.8 - 6.3]
2015-16	WINTER	Wyoming	28	20	2	6	19,395	18.1 [12.4 - 25]	26.5 [15.7 - 37.2]	71.4	1.7	20	338	22.7 [16.2 - 30.2]	28.3 [32.8 - 7.3]	8	19,057	18 [8 - 32.4]	21.8 [17 - 6]
2015-16	WINTER	Other	0																
2015-16	WINTER	MultiStateOperation	162	75	16	71	338,628	26.4 [23.8 - 29.2]	26.6 [23 - 30.3]	0.0	0.0	162	338,628	26.4 [23.8 - 29.2]	26.6 [23.7 - 1.9]	162	338,628	26.4 [23.8 - 29.2]	26.6 [23.7 - 1.9]
2016-17	WINTER	Alabama	43	42	1	0	473	25.2 [17.6 - 34]	32.9 [22.5 - 43.3]	97.7	98.3	42	465	25.4 [17.6 - 34.3]	33.4 [35.1 - 5.4]	1	(D)	(D)	(D)
2016-17	WINTER	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2016-17	WINTER	Arizona	10	9	1	0	474	61.9 [46.7 - 75.6]	24.1 [7.2 - 41]	80.0	11.0	8	52	11.1 [1.8 - 31]	20 [24.3 - 8.6]	2	(D)	(D)	(D)
2016-17	WINTER	Arkansas	39	35	2	2	2,429	17.4 [15.2 - 19.8]	19.6 [11.9 - 27.3]	92.3	14.8	36	359	14.7 [10 - 20.5]	19.5 [25.5 - 4.2]	3	(D)	(D)	(D)
2016-17	WINTER	California	184	110	22	52	298,101	18.1 [16.1 - 20.3]	29.6 [25.1 - 34]	66.3	19.2	122	57,352	19 [16.3 - 22]	32.2 [34.8 - 3.2]	62	240,749	17.9 [14.5 - 21.7]	24.4 [19.6 - 2.5]
2016-17	WINTER	Colorado	131	129	2	0	768	36.2 [31.2 - 41.3]	48 [41 - 54.9]	96.2	93.5	126	718	35.5 [30.4 - 40.9]	48.7 [40.8 - 3.6]	5	50	46 [33.1 - 59.2]	30 [27.4 - 12.2]
2016-17	WINTER	Connecticut	44	43	1	0	391	54.9 [46.1 - 63.4]	49.8 [38.4 - 61.3]	100.0	100.0	44	391	54.9 [46.1 - 63.4]	49.8 [38.7 - 5.8]	0			
2016-17	WINTER	District of Columbia	25	25	0	0	101	38.9 [26.7 - 52.1]	55.1 [38.7 - 71.5]	88.0	90.1	22	91	41.7 [28.6 - 55.6]	57.6 [40.7 - 8.7]	3	(D)	(D)	(D)

			All operations in the State									Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2016-17	WINTER	Delaware	46	45	1	0	411	69 [58.9 - 78]	51.2 [40.2 - 62.2]	87.0	83.9	40	345	75.3 [65.7 - 83.5]	50.9 [37.9 - 6]	6	66	38.9 [13 - 70.2]	53.2 [42.9 - 17.5]
2016-17	WINTER	Florida	67	50	10	7	72,665	19 [15.4 - 23]	28.2 [21 - 35.5]	83.6	2.5	56	1,812	23.6 [19 - 28.6]	29.2 [32.1 - 4.3]	11	70,853	18.9 [10.5 - 29.7]	23.6 [16.8 - 5.1]
2016-17	WINTER	Georgia	87	72	8	7	25,580	12.8 [9.7 - 16.2]	34.9 [28.8 - 40.9]	88.5	8.8	77	2,262	29.3 [22.9 - 36.3]	37.4 [29 - 3.3]	10	23,318	11.2 [4.9 - 20.7]	15.1 [16.2 - 5.1]
2016-17	WINTER	Hawaii	10	10	0	0	77	26.2 [11.5 - 45.7]	26.4 [4.4 - 48.3]	100.0	100.0	10	77	26.2 [11.5 - 45.7]	26.4 [35.4 - 11.2]	0			
2016-17	WINTER	Idaho	40	33	1	6	51,318	12.8 [8.8 - 17.7]	54.8 [42.7 - 66.9]	87.5	2.2	35	1,114	20.4 [14.1 - 27.9]	60.1 [38.4 - 6.5]	5	50,204	12.7 [3.2 - 30.1]	17.5 [15.3 - 6.8]
2016-17	WINTER	Illinois	121	118	2	1	2,053	54 [49.9 - 57.9]	56.6 [49.8 - 63.5]	97.5	44.5	118	913	49.4 [43.5 - 55.2]	57 [38.4 - 3.5]	3	(D)	(D)	(D)
2016-17	WINTER	Indiana	119	115	3	1	3,881	23 [20.1 - 26.1]	33.6 [27.9 - 39.2]	99.2	27.9	118	1,081	36.1 [31.3 - 41.1]	33.7 [31.4 - 2.9]	1	(D)	(D)	(D)
2016-17	WINTER	Iowa	85	83	2	0	788	46.6 [39.8 - 53.4]	39.4 [31.7 - 47.1]	97.6	95.2	83	750	47.7 [40.9 - 54.6]	39 [35.9 - 3.9]	2	(D)	(D)	(D)
2016-17	WINTER	Kansas	24	23	0	1	17,178	39.8 [38.8 - 40.9]	35.7 [21.9 - 49.6]	91.7	1.0	22	175	21.9 [14.8 - 30.4]	32.6 [33.2 - 7.1]	2	(D)	(D)	(D)
2016-17	WINTER	Kentucky	53	50	1	2	1,649	17.6 [13 - 22.9]	30.1 [21 - 39.1]	94.3	30.3	50	499	35.7 [28.5 - 43.4]	31.2 [34.2 - 4.8]	3	(D)	(D)	(D)
2016-17	WINTER	Louisiana	24	20	2	2	4,679	32.3 [28.3 - 36.5]	28.2 [16.9 - 39.5]	91.7	9.4	22	439	25.9 [17.1 - 36.1]	28.5 [29.3 - 6.2]	2	(D)	(D)	(D)
2016-17	WINTER	Maine	85	78	4	3	30,652	16.3 [14.4 - 18.3]	53.4 [45.2 - 61.6]	94.1	2.0	80	613	45.5 [39.3 - 51.8]	54.6 [38.4 - 4.3]	5	30,039	15.8 [9.3 - 24.2]	33.1 [40.5 - 18.1]
2016-17	WINTER	Maryland	162	156	3	3	4,319	41.6 [39.1 - 44.2]	41.9 [36.1 - 47.7]	92.0	35.5	149	1,533	43.7 [39.5 - 48]	42 [38.4 - 3.1]	13	2,786	40.4 [37 - 43.9]	40.1 [26.5 - 7.3]
2016-17	WINTER	Massachusetts	113	112	0	1	21,497	15.7 [14.6 - 16.8]	50.7 [43.7 - 57.6]	95.6	2.3	108	504	41.5 [35.4 - 47.8]	50.8 [37.8 - 3.6]	5	20,993	15.2 [13.9 - 16.6]	48.6 [37.1 - 16.6]
2016-17	WINTER	Michigan	177	166	8	3	11,816	20.5 [18.1 - 23.1]	59.3 [53.9 - 64.6]	97.2	15.9	172	1,874	42 [37.4 - 46.7]	60.3 [36.1 - 2.8]	5	9,942	16.8 [9.6 - 26]	24.7 [17.1 - 7.7]
2016-17	WINTER	Minnesota	107	94	6	7	13,893	22.5 [18.7 - 26.6]	53.4 [46 - 60.7]	90.7	17.0	97	2,356	27.3 [23.1 - 31.7]	55.3 [38.9 - 3.9]	10	11,537	21.8 [10.6 - 36.8]	35.2 [33.6 - 10.6]
2016-17	WINTER	Mississippi	9	4	1	4	11,793	6.6 [3.7 - 10.6]	15.3 [4.8 - 25.7]	22.2	0.1	2	(D)	(D)	(D)	7	11,776	6.6 [3.4 - 11.2]	14.9 [15.7 - 6]
2016-17	WINTER	Missouri	113	110	3	0	1,086	24.1 [20.5 - 28]	28.9 [22.8 - 35.1]	96.5	91.0	109	988	23 [19.3 - 26.9]	28 [33.2 - 3.2]	4	(D)	(D)	(D)
2016-17	WINTER	Montana	28	19	2	7	38,962	10.5 [7.2 - 14.7]	38.5 [24.9 - 52.1]	60.7	0.3	17	100	30 [17.5 - 44.9]	43.7 [37.8 - 9.2]	11	38,862	10.5 [5.4 - 17.6]	30.4 [34.9 - 10.5]
2016-17	WINTER	Nebraska	22	22	0	0	215	56.7 [45.5 - 67.5]	62.3 [48.4 - 76.2]	90.9	90.7	20	195	54.2 [42.5 - 65.5]	59.7 [33.6 - 7.5]	2	(D)	(D)	(D)
2016-17	WINTER	Nevada	15	14	0	1	1,688	7.3 [2.5 - 15.6]	45.9 [25.9 - 65.9]	93.3	5.2	14	88	57.8 [40.6 - 73.8]	48.8 [39.3 - 10.5]	1	(D)	(D)	(D)
2016-17	WINTER	New Hampshire	59	58	1	0	712	54.1 [48.1 - 60]	58.3 [48.5 - 68.1]	93.2	43.4	55	309	59.8 [50.9 - 68.3]	58 [38.2 - 5.2]	4	(D)	(D)	(D)
2016-17	WINTER	New Jersey	83	80	2	1	2,962	17.6 [13.4 - 22.3]	38.2 [30.8 - 45.6]	94.0	23.5	78	696	38.3 [32.4 - 44.5]	37.8 [34 - 3.9]	5	2,266	11.2 [2.8 - 26.6]	45 [45.8 - 20.5]
2016-17	WINTER	New Mexico	25	23	2	0	382	37.8 [28.5 - 47.7]	58.2 [43.9 - 72.4]	96.0	41.1	24	157	44.1 [29.8 - 59.1]	59.2 [36.7 - 7.5]	1	(D)	(D)	(D)
2016-17	WINTER	New York	169	151	9	9	19,910	25 [22.6 - 27.6]	47.2 [41.6 - 52.8]	92.3	16.0	156	3,183	46.7 [43.1 - 50.4]	48.7 [37.6 - 3]	13	16,727	21.5 [15.3 - 28.8]	29 [26.1 - 7.2]
2016-17	WINTER	North Carolina	231	224	5	2	5,983	15.4 [12.9 - 18.1]	31.1 [26.7 - 35.5]	95.7	27.2	221	1,626	30.2 [26.7 - 33.8]	31.2 [34.4 - 2.3]	10	4,357	9.3 [3.4 - 19]	27.8 [31.8 - 10.1]
2016-17	WINTER	North Dakota	21	6	0	15	117,600	22.1 [15.9 - 29.3]	44.5 [31.8 - 57.3]	23.8	0.0	5	18	70 [46.5 - 87.9]	81.4 [25.6 - 11.4]	16	117,582	22.1 [15 - 30.5]	33 [20.4 - 5.1]
2016-17	WINTER	Ohio	284	280	4	0	2,280	31.5 [28.1 - 35.1]	42 [37.5 - 46.5]	97.9	93.6	278	2,135	32.2 [28.6 - 35.8]	42.1 [38.9 - 2.3]	6	145	22.1 [12 - 35]	39.3 [23.4 - 9.5]
2016-17	WINTER	Oklahoma	34	31	1	2	2,070	43.6 [36.2 - 51.1]	12.8 [6.4 - 19.1]	97.1	40.9	33	846	11.5 [8.7 - 14.9]	11.4 [17.5 - 3.1]	1	(D)	(D)	(D)
2016-17	WINTER	Oregon	170	160	3	7	37,559	20.4 [17.7 - 23.3]	44.2 [38.7 - 49.7]	94.1	4.8	160	1,806	57.2 [53.1 - 61.2]	45.1 [36.7 - 2.9]	10	35,753	18.7 [9.7 - 30.6]	30 [33.2 - 10.5]
2016-17	WINTER	Pennsylvania	754	729	21	4	11,794	39.7 [37.8 - 41.6]	58 [55.3 - 60.6]	97.7	51.6	737	6,089	53.7 [51.4 - 56]	58.3 [37.6 - 1.4]	17	5,705	28 [21.2 - 35.5]	43.5 [34.1 - 8.3]
2016-17	WINTER	Puerto Rico	0																
2016-17	WINTER	Rhode Island	19	19	0	0	74	36.5 [22.7 - 51.9]	47.2 [29.5 - 64.8]	84.2	63.5	16	47	42.6 [25.7 - 60.7]	48 [41.7 - 10.4]	3	(D)	(D)	(D)
2016-17	WINTER	South Carolina	57	54	1	2	2,253	32.8 [29.2 - 36.6]	29.8 [21 - 38.7]	94.7	18.8	54	424	27.6 [21.3 - 34.7]	30.4 [34.6 - 4.7]	3	(D)	(D)	(D)
2016-17	WINTER	South Dakota	13	8	1	4	21,487	24.5 [21.2 - 28.1]	35.8 [17.9 - 53.7]	53.8	0.6	7	137	11.1 [1.1 - 36.4]	33.8 [41.4 - 15.6]	6	21,350	24.6 [19.8 - 29.9]	38.1 [23.3 - 9.5]
2016-17	WINTER	Tennessee	66	63	3	0	821	25.3 [19.7 - 31.5]	28.7 [21.3 - 36.1]	100.0	100.0	66	821	25.3 [19.7 - 31.5]	28.7 [30.6 - 3.8]	0			
2016-17	WINTER	Texas	146	132	5	9	40,602	16.5 [14.1 - 19]	17.2 [13 - 21.4]	93.2	13.3	136	5,414	16.6 [13.8 - 19.6]	16.6 [26.1 - 2.2]	10	35,188	16.4 [8.3 - 27.6]	24.7 [24.2 - 7.7]
2016-17	WINTER	Utah	232	229	2	1	2,763	45.2 [42 - 48.5]	66.6 [61.5 - 71.7]	97.8	35.1	227	970	49.3 [44.2 - 54.5]	67.1 [39.5 - 2.6]	5	1,793	42.6 [35.9 - 49.5]	45 [25.3 - 11.3]
2016-17	WINTER	Vermont	52	47	4	1	1,710	37.8 [33 - 42.7]	56.6 [46.7 - 66.4]	94.2	74.7	49	1,277	32.4 [28 - 37.1]	55.2 [36.6 - 5.2]	3	(D)	(D)	(D)
2016-17	WINTER	Virginia	444	436	8	0	2,887	36 [33.3 - 38.8]	35.5 [32.2 - 38.9]	97.1	87.6	431	2,528	33 [30.2 - 35.8]	35.3 [36.1 - 1.7]	13	359	56.1 [44.3 - 67.4]	42 [28.8 - 8]
2016-17	WINTER	Washington	113	101	5	7	73,349	28.2 [26.4 - 30.1]	46.9 [39.8 - 54]	91.2	1.4	103	1,017	41.5 [35.9 - 47.2]	49.1 [39.4 - 3.9]	10	72,332	28 [22.3 - 34.3]	24.2 [13.4 - 4.2]
2016-17	WINTER	West Virginia	60	56	4	0	875	17.1 [12.7 - 22.1]	21.5 [14.8 - 28.2]	95.0	85.7	57	750	17.9 [13.1 - 23.4]	22.1 [27 - 3.6]	3	(D)	(D)	(D)
2016-17	WINTER	Wisconsin	140	127	10	3	13,991	18.8 [15.3 - 22.6]	55.5 [49.5 - 61.6]	95.0	15.1	133	2,112	50.7 [46 - 55.4]	56.3 [36.6 - 3.2]	7	11,879	13.1 [4.4 - 27.5]	41.7 [36.9 - 13.9]
2016-17	WINTER	Wyoming	20	17	1	2	5,487	17.9 [14 - 22.2]	33.9 [19.2 - 48.6]	75.0	1.4	15	79	30.4 [17.3 - 46.1]	31.5 [36.4 - 9.4]	5	5,408	17.7 [10.5 - 26.9]	40.9 [25.1 - 11.2]
2016-17	WINTER	Other	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2016-17	WINTER	MultiStateOperation	139	60	23	56	261,997	18.8 [16.4 - 21.3]	34.4 [29.5 - 39.3]	0.0	0.0	139	261,997	18.8 [16.4 - 21.3]	34.4 [29.4 - 2.5]	139	261,997	18.8 [16.4 - 21.3]	34.4 [29.4 - 2.5]
2010-11	ANNUAL	Alabama	19	18	1	0	307	14.2 [7.7 - 22.8]	27 [16 - 38.1]	94.7	96.1	18	295	13.2 [7 - 21.7]	25.7 [24.6 - 5.8]	1	(D)	(D)	(D)
2010-11	ANNUAL	Alaska	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	ANNUAL	Arizona	6	5	0	1	1,620	23.4 [20 - 27]	26.5 [1.4 - 51.6]	83.3	0.9	5	14	33.3 [7.8 - 69]	27.1 [35 - 15.7]	1	(D)	(D)	(D)
2010-11	ANNUAL	Arkansas	14	14	0	0	49	31.6 [20.1 - 44.8]	19.8 [7.5 - 32]	85.7	79.6	12	39	39 [27.4 - 51.4]	22 [24.5 - 7.1]	2	(D)	(D)	(D)
2010-11	ANNUAL	California	142	104	9	29	84,959	35.6 [31.9 - 39.4]	41.4 [36 - 46.9]	79.6	11.8	113	9,988	32.5 [29.8 - 35.3]	41.3 [34.6 - 3.3]	29	74,971	35.9 [27.6 - 44.9]	41.8 [28 - 5.2]
2010-11	ANNUAL	Colorado	61	59	2	0	403	38.2 [33.3 - 43.4]	33.8 [26.1 - 41.5]	98.4	79.7	60	321	35.8 [30.4 - 41.5]	33.6 [30.8 - 4]	1	(D)	(D)	(D)
2010-11	ANNUAL	Connecticut	42	40	2	0	389	43.1 [36.3 - 50.1]	47.3 [37.4 - 57.3]	85.7	38.0	36	148	57.1 [46.6 - 67.2]	48 [35.1 - 5.9]	6	241	35 [28.4 - 42.1]	43.5 [15.9 - 6.5]
2010-11	ANNUAL	District of Columbia	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	ANNUAL	Delaware	7	7	0	0	24	30.6 [12.3 - 54.5]	18.7 [-2 - 39.4]	85.7	79.2	6	19	18.5 [5.1 - 40.9]	10.7 [20.1 - 8.2]	1	(D)	(D)	(D)
2010-11	ANNUAL	Florida	56	51	2	3	5,564	57.7 [50.3 - 64.9]	31.7 [24.1 - 39.2]	91.1	7.0	51	388	26.9 [21.2 - 33.2]	30.2 [28.5 - 4]	5	5,176	59.6 [33.3 - 82.6]	46.8 [30.9 - 13.8]
2010-11	ANNUAL	Georgia	60	58	1	1	1,213	84.8 [80.7 - 88.4]	31.2 [23.4 - 38.9]	96.7	20.8	58	252	42.4 [36.4 - 48.5]	29 [28.7 - 3.8]	2	(D)	(D)	(D)
2010-11	ANNUAL	Hawaii	31	27	3	1	4,987	7.9 [3.7 - 14.1]	52.6 [39.1 - 66.1]	100.0	100.0	31	4,987	7.9 [3.7 - 14.1]	52.6 [38.5 - 6.9]	0			
2010-11	ANNUAL	Idaho	13	11	0	2	8,428	20.6 [17.3 - 24.3]	52 [33.1 - 71]	84.6	0.3	11	28	46.2 [31.5 - 61.3]	58.3 [34.2 - 10.3]	2	(D)	(D)	(D)
2010-11	ANNUAL	Illinois	55	52	3	0	404	58 [50.2 - 65.5]	49.6 [39.6 - 59.7]	94.5	79.7	52	322	41.9 [34.3 - 49.9]	48.7 [38.9 - 5.4]	3	(D)	(D)	(D)
2010-11	ANNUAL	Indiana	59	57	1	1	3,458	33.8 [31.8 - 35.8]	39.8 [30.9 - 48.8]	98.3	7.5	58	258	39.6 [32.6 - 46.8]	39.9 [35.3 - 4.6]	1	(D)	(D)	(D)
2010-11	ANNUAL	Iowa	14	12	2	0	183	80.7 [71.6 - 88.1]	53.2 [36.7 - 69.7]	85.7	68.9	12	126	80.6 [67.7 - 90.2]	51.2 [33.2 - 9.6]	2	(D)	(D)	(D)
2010-11	ANNUAL	Kansas	11	10	1	0	104	38.9 [24.3 - 54.9]	30.9 [13.7 - 48]	81.8	51.9	9	54	23.5 [10.5 - 41.1]	27.4 [29.6 - 9.9]	2	(D)	(D)	(D)
2010-11	ANNUAL	Kentucky	21	20	1	0	258	33.5 [24.2 - 43.7]	42 [25.8 - 58.1]	95.2	98.4	20	254	34.1 [24.4 - 44.7]	43 [38.4 - 8.6]	1	(D)	(D)	(D)
2010-11	ANNUAL	Louisiana	12	9	2	1	3,958	63.6 [59.6 - 67.5]	34.9 [17 - 52.9]	83.3	2.5	10	98	26.1 [16 - 38.3]	28.8 [31.2 - 9.9]	2	(D)	(D)	(D)
2010-11	ANNUAL	Maine	42	41	0	1	1,128	86.9 [83.1 - 90.2]	62.3 [50.9 - 73.7]	92.9	13.8	39	156	49.8 [39.6 - 60.1]	63.5 [37.9 - 6.1]	3	(D)	(D)	(D)
2010-11	ANNUAL	Maryland	82	81	1	0	378	47 [42.2 - 51.9]	41.6 [34.9 - 48.4]	98.8	97.6	81	369	46.9 [42 - 51.8]	41.5 [31.4 - 3.5]	1	(D)	(D)	(D)
2010-11	ANNUAL	Massachusetts	78	78	0	0	301	60.8 [54.2 - 67.2]	58.3 [50.4 - 66.1]	93.6	83.7	73	252	61.1 [53.9 - 67.9]	58.6 [36.4 - 4.3]	5	49	58.7 [44.1 - 72.4]	53.9 [16.2 - 7.2]
2010-11	ANNUAL	Michigan	95	85	7	3	5,896	83.5 [80.3 - 86.4]	63.8 [56.7 - 70.8]	96.8	21.9	92	1,290	75 [70.5 - 79.2]	63.7 [35.4 - 3.7]	3	(D)	(D)	(D)
2010-11	ANNUAL	Minnesota	27	21	1	5	23,352	42.5 [36.5 - 48.6]	60.9 [49.5 - 72.4]	77.8	1.3	21	309	59.3 [48.5 - 69.6]	65 [32.1 - 7]	6	23,043	42.1 [29.3 - 55.7]	46.6 [19 - 7.8]
2010-11	ANNUAL	Mississippi	7	4	0	3	19,520	43.4 [26 - 62]	48.5 [23 - 73.9]	57.1	0.1	4	(D)	(D)	(D)	3	(D)	(D)	(D)
2010-11	ANNUAL	Missouri	71	71	0	0	391	26.8 [21.8 - 32.2]	31.5 [24.5 - 38.5]	97.2	93.6	69	366	27.1 [22 - 32.7]	32 [30.2 - 3.6]	2	(D)	(D)	(D)
2010-11	ANNUAL	Montana	15	10	0	5	14,788	19.6 [15.7 - 23.9]	58.8 [39.1 - 78.5]	66.7	0.6	10	88	81.9 [68.1 - 91.7]	77.3 [34.2 - 10.8]	5	14,700	19.2 [13.8 - 25.5]	21.7 [9.9 - 4.4]
2010-11	ANNUAL	Nebraska	8	7	0	1	8,064	18.3 [16 - 20.7]	40.8 [22.1 - 59.5]	87.5	0.8	7	64	39.6 [25.9 - 54.4]	44.1 [27.4 - 10.3]	1	(D)	(D)	(D)
2010-11	ANNUAL	Nevada	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	ANNUAL	New Hampshire	28	27	1	0	305	35.4 [25.6 - 46]	62.4 [49.3 - 75.4]	100.0	100.0	28	305	35.4 [25.6 - 46]	62.4 [35.3 - 6.7]	0			
2010-11	ANNUAL	New Jersey	37	36	1	0	169	27.8 [21.3 - 34.9]	26.4 [16.5 - 36.3]	97.3	99.4	36	168	28.1 [21.5 - 35.4]	26.7 [31 - 5.2]	1	(D)	(D)	(D)
2010-11	ANNUAL	New Mexico	9	9	0	0	17	10.3 [1.7 - 28.9]	16.1 [-5.4 - 37.6]	100.0	100.0	9	17	10.3 [1.7 - 28.9]	16.1 [33 - 11]	0			
2010-11	ANNUAL	New York	78	71	5	2	2,842	68.1 [60.9 - 74.8]	52.5 [45.5 - 59.5]	87.2	14.6	68	414	49.2 [42.8 - 55.7]	55 [32.1 - 3.9]	10	2,428	70 [48.2 - 86.9]	35.6 [22.5 - 7.1]
2010-11	ANNUAL	North Carolina	293	287	6	0	2,247	42.3 [38.6 - 46]	29.9 [26.5 - 33.3]	95.6	91.9	280	2,064	42 [38.2 - 45.9]	29.5 [29.4 - 1.8]	13	183	44.6 [30.3 - 59.6]	40.1 [34.3 - 9.5]
2010-11	ANNUAL	North Dakota	14	5	2	7	39,557	27.5 [19.4 - 36.8]	41.7 [22.7 - 60.7]	35.7	0.0	5	8	57.1 [14.7 - 92.7]	40 [54.8 - 24.5]	9	39,549	27.5 [17.4 - 39.4]	42.7 [25.2 - 8.4]
2010-11	ANNUAL	Ohio	110	110	0	0	424	39.8 [34.4 - 45.3]	37.5 [30.9 - 44.1]	100.0	100.0	110	424	39.8 [34.4 - 45.3]	37.5 [35.2 - 3.4]	0			
2010-11	ANNUAL	Oklahoma	15	13	2	0	321	32 [25.1 - 39.4]	31.2 [18.1 - 44.3]	80.0	95.3	12	306	32.3 [24.8 - 40.5]	34.4 [26.6 - 7.7]	3	(D)	(D)	(D)
2010-11	ANNUAL	Oregon	73	69	2	2	11,920	19.9 [18.3 - 21.5]	30.1 [22.7 - 37.6]	91.8	2.2	67	266	37.9 [31.2 - 45]	31.6 [33.4 - 4.1]	6	11,654	19.4 [16 - 23.1]	14.1 [11.4 - 4.6]
2010-11	ANNUAL	Pennsylvania	207	197	9	1	2,786	72.8 [69 - 76.3]	50.6 [45.8 - 55.4]	97.1	54.3	201	1,512	48.8 [45 - 52.6]	50.5 [35.2 - 2.5]	6	1,274	84.1 [65.9 - 95.1]	53.7 [27.8 - 11.4]
2010-11	ANNUAL	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	ANNUAL	Rhode Island	25	25	0	0	84	48.7 [36.6 - 60.9]	52 [35.8 - 68.2]	96.0	96.4	24	81	49.1 [36.5 - 61.8]	52.5 [42.1 - 8.6]	1	(D)	(D)	(D)
2010-11	ANNUAL	South Carolina	42	41	1	0	865	24.8 [19.6 - 30.5]	31.2 [23.9 - 38.5]	88.1	25.5	37	221	35.3 [28.7 - 42.4]	30.4 [24.2 - 4]	5	644	19.4 [8.8 - 34.2]	37.1 [26.7 - 11.9]
2010-11	ANNUAL	South Dakota	6	5	0	1	933	44.8 [40.3 - 49.3]	32.9 [1.4 - 64.3]	83.3	3.5	5	33	78 [48.1 - 95.5]	30.6 [43.4 - 19.4]	1	(D)	(D)	(D)
2010-11	ANNUAL	Tennessee	43	42	1	0	267	36.4 [28.3 - 45]	31 [21.3 - 40.7]	90.7	80.1	39	214	27 [20.2 - 34.5]	30.5 [31.7 - 5.1]	4	(D)	(D)	(D)
2010-11	ANNUAL	Texas	36	28	1	7	30,219	30.2 [25 - 35.8]	20.7 [12.7 - 28.7]	77.8	2.6	28	772	40 [35.8 - 44.2]	16.5 [23.4 - 4.4]	8	29,447	30 [18.9 - 42.9]	35.2 [24.2 - 8.6]
2010-11	ANNUAL	Utah	46	45	0	1	1,778	27.1 [22.8 - 31.8]	34.7 [25.6 - 43.8]	95.7	8.7	44	154	35.9 [28.5 - 43.7]	33.7 [31.1 - 4.7]	2	(D)	(D)	(D)
2010-11	ANNUAL	Vermont	35	34	0	1	790	25.5 [18.8 - 33.1]	41.5 [29.3 - 53.8]	88.6	18.9	31	149	44.3 [32.1 - 57]	41.2 [38.4 - 6.9]	4	(D)	(D)	(D)
2010-11	ANNUAL	Virginia	171	169	2	0	804	40.4 [36.2 - 44.7]	34.1 [29.1 - 39.1]	97.7	94.5	167	760	40.9 [36.6 - 45.2]	34.2 [33.4 - 2.6]	4	(D)	(D)	(D)
2010-11	ANNUAL	Washington	68	60	3	5	14,664	20.6 [18.7 - 22.5]	36.3 [28.6 - 44.1]	89.7	2.3	61	340	36 [30 - 42.4]	38 [33.8 - 4.3]	7	14,324	20.1 [15.2 - 25.7]	21.3 [12.6 - 4.7]
2010-11	ANNUAL	West Virginia	25	24	1	0	193	78.6 [63.8 - 89.6]	40.7 [25.7 - 55.8]	92.0	48.7	23	94	41.3 [27.6 - 55.9]	36.9 [37.3 - 7.8]	2	(D)	(D)	(D)
2010-11	ANNUAL	Wisconsin	50	48	1	1	3,773	34.6 [32.1 - 37.1]	51.9 [42.5 - 61.2]	92.0	14.0	46	529	41.8 [35.4 - 48.5]	52.7 [34.8 - 5.1]	4	(D)	(D)	(D)
2010-11	ANNUAL	Wyoming	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2010-11	ANNUAL	Other	0																
2010-11	ANNUAL	MultiStateOperation	76	37	15	24	77,904	36.2 [30.9 - 41.6]	40 [33.9 - 46]	0.0	0.0	76	77,904	36.2 [30.9 - 41.6]	40 [26.9 - 3.1]	76	77,904	36.2 [30.9 - 41.6]	40 [26.9 - 3.1]
2011-12	ANNUAL	Alabama	25	24	1	0	388	27 [21.2 - 33.4]	17.8 [10.2 - 25.5]	96.0	99.7	24	387	26.8 [20.8 - 33.4]	17.1 [19.5 - 4]	1	(D)	(D)	(D)
2011-12	ANNUAL	Alaska	0																
2011-12	ANNUAL	Arizona	7	5	2	0	275	26.8 [22 - 32]	19.3 [8.8 - 29.7]	71.4	47.3	5	130	31.6 [24.8 - 38.8]	18.3 [17.1 - 7.6]	2	(D)	(D)	(D)
2011-12	ANNUAL	Arkansas	25	23	2	0	273	38.2 [29.2 - 47.8]	39.9 [27.3 - 52.5]	96.0	76.2	24	208	38.3 [27.7 - 49.7]	40 [32.8 - 6.7]	1	(D)	(D)	(D)
2011-12	ANNUAL	California	188	140	18	30	118,536	29.6 [27 - 32.2]	36.6 [32.1 - 41.1]	81.9	28.1	154	33,265	21.4 [18.1 - 24.9]	38 [33.9 - 2.7]	34	85,271	32.2 [27 - 37.8]	30.5 [15.3 - 2.6]
2011-12	ANNUAL	Colorado	69	66	3	0	544	38.1 [33.4 - 43]	46.6 [39.8 - 53.4]	98.6	77.0	68	419	43.9 [39.6 - 48.3]	47.1 [28.7 - 3.5]	1	(D)	(D)	(D)
2011-12	ANNUAL	Connecticut	31	30	1	0	224	24.3 [15.7 - 34.6]	29.2 [18.6 - 39.8]	87.1	45.5	27	102	35.3 [25.3 - 46.2]	30.3 [30.8 - 5.9]	4	(D)	(D)	(D)
2011-12	ANNUAL	District of Columbia	5	4	0	1	1,266	85.3 [74.6 - 92.9]	19.4 [-13.7 - 52.5]	100.0	100.0	5	1,266	85.3 [74.6 - 92.9]	19.4 [37.8 - 16.9]	0			
2011-12	ANNUAL	Delaware	20	18	2	0	138	52.2 [40.2 - 64]	30.5 [18.6 - 42.4]	90.0	79.7	18	110	34.4 [21.5 - 49.1]	28.2 [27 - 6.4]	2	(D)	(D)	(D)

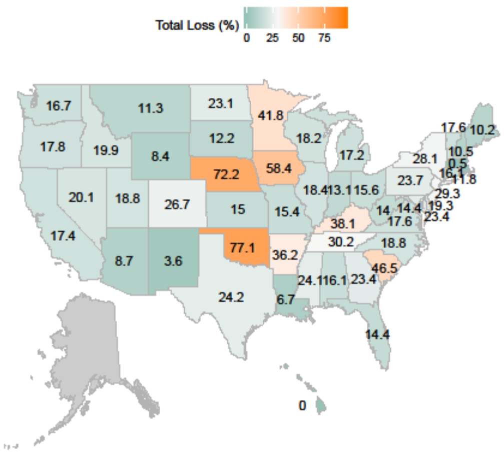
			All operations in the State									Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2011-12	ANNUAL	Florida	78	65	4	9	28,095	44.6 [41 - 48.2]	26.3 [20.6 - 32]	88.5	12.3	69	3,449	25.5 [19.8 - 31.9]	25.4 [26.4 - 3.2]	9	24,646	46.4 [37.3 - 55.7]	33.9 [19.4 - 6.5]
2011-12	ANNUAL	Georgia	98	93	2	3	7,617	54.7 [52.5 - 56.9]	28.4 [23.3 - 33.6]	91.8	9.8	90	750	33.7 [27.8 - 40.1]	28.1 [26.4 - 2.8]	8	6,867	56 [51 - 60.9]	32.1 [21.1 - 7.4]
2011-12	ANNUAL	Hawaii	20	15	2	3	11,097	20.4 [12.2 - 30.7]	34 [20.4 - 47.5]	100.0	100.0	20	11,097	20.4 [12.2 - 30.7]	34 [30.9 - 6.9]	0			
2011-12	ANNUAL	Idaho	22	19	0	3	5,416	24.7 [18.7 - 31.5]	34.1 [21.4 - 46.7]	81.8	1.3	18	73	31 [22.7 - 40.3]	33.7 [30.3 - 7.2]	4	(D)	(D)	(D)
2011-12	ANNUAL	Illinois	54	52	2	0	407	52.6 [46.1 - 59]	38.4 [29 - 47.8]	98.1	78.6	53	320	46.1 [38.5 - 53.8]	37.9 [35.3 - 4.8]	1	(D)	(D)	(D)
2011-12	ANNUAL	Indiana	62	59	2	1	1,421	19.2 [16.6 - 22]	23 [16.7 - 29.3]	95.2	28.5	59	405	19.2 [14.7 - 24.3]	23.7 [25.8 - 3.4]	3	(D)	(D)	(D)
2011-12	ANNUAL	Iowa	24	22	2	0	258	45.8 [37.1 - 54.6]	21.7 [13.5 - 29.8]	95.8	66.3	23	171	25.2 [19.5 - 31.5]	19.8 [18.8 - 3.9]	1	(D)	(D)	(D)
2011-12	ANNUAL	Kansas	15	12	3	0	454	34.1 [25.7 - 43.3]	25.3 [9.7 - 40.9]	86.7	33.9	13	154	28.1 [15.1 - 44.3]	23.3 [32.8 - 9.1]	2	(D)	(D)	(D)
2011-12	ANNUAL	Kentucky	30	28	2	0	371	36 [30.3 - 41.9]	31.3 [21.9 - 40.7]	96.7	97.3	29	361	37.3 [31.6 - 43.3]	31.8 [26.6 - 4.9]	1	(D)	(D)	(D)
2011-12	ANNUAL	Louisiana	14	12	2	0	891	50.3 [41.3 - 59.3]	43.1 [27.2 - 59]	100.0	100.0	14	891	50.3 [41.3 - 59.3]	43.1 [30.4 - 8.1]	0			
2011-12	ANNUAL	Maine	77	70	4	3	18,177	51.5 [49.8 - 53.1]	21.1 [16 - 26.2]	92.2	2.5	71	459	21.9 [18.3 - 25.6]	19.8 [22.5 - 2.7]	6	17,718	52.1 [47.3 - 57]	36.3 [21.2 - 8.7]
2011-12	ANNUAL	Maryland	202	200	2	0	797	37.6 [33.8 - 41.5]	26.9 [22.5 - 31.2]	98.5	95.4	199	760	32.1 [28.4 - 35.9]	26.8 [31.7 - 2.3]	3	(D)	(D)	(D)
2011-12	ANNUAL	Massachusetts	129	125	3	1	13,079	47.8 [46.8 - 48.7]	35.6 [29.8 - 41.3]	95.3	3.4	123	451	39.6 [34.5 - 44.9]	35.4 [33.6 - 3]	6	12,628	48 [47.1 - 48.9]	39.7 [24.4 - 9.9]
2011-12	ANNUAL	Michigan	119	109	7	3	6,003	22.6 [20 - 25.3]	34.3 [28.2 - 40.4]	97.5	16.7	116	1,003	36.9 [33.2 - 40.8]	34.8 [34.1 - 3.2]	3	(D)	(D)	(D)
2011-12	ANNUAL	Minnesota	33	32	1	0	387	37.1 [30.4 - 44.1]	42.4 [29.5 - 55.3]	97.0	96.9	32	375	37.7 [30.9 - 44.9]	43.1 [38.2 - 6.8]	1	(D)	(D)	(D)
2011-12	ANNUAL	Mississippi	5	5	0	0	33	21.3 [11.2 - 34.4]	18.8 [6.9 - 30.8]	100.0	100.0	5	33	21.3 [11.2 - 34.4]	18.8 [13.6 - 6.1]	0			
2011-12	ANNUAL	Missouri	56	52	4	0	519	25.9 [22.7 - 29.4]	18.1 [13.7 - 22.5]	96.4	60.7	54	315	21.5 [18.2 - 25]	17.1 [16.1 - 2.2]	2	(D)	(D)	(D)
2011-12	ANNUAL	Montana	16	9	1	6	21,511	15.8 [12 - 20.1]	25.9 [13.7 - 38.2]	62.5	5.1	10	1,091	19.9 [17.4 - 22.7]	26.5 [30.3 - 9.6]	6	20,420	15.5 [9.4 - 23.4]	24.9 [14.8 - 6]
2011-12	ANNUAL	Nebraska	6	5	0	1	9,514	25.8 [24.3 - 27.4]	43.5 [15.6 - 71.3]	83.3	0.1	5	14	41.9 [13.5 - 75]	47 [37.7 - 16.9]	1	(D)	(D)	(D)
2011-12	ANNUAL	Nevada	11	8	2	1	1,602	32.8 [29.5 - 36.2]	35.1 [20.3 - 50]	72.7	3.2	8	52	29.9 [16.2 - 46.5]	35.4 [29.3 - 10.3]	3	(D)	(D)	(D)
2011-12	ANNUAL	New Hampshire	34	32	2	0	363	31 [25.8 - 36.5]	28.2 [19.8 - 36.6]	88.2	82.4	30	299	29.4 [23.8 - 35.5]	27.6 [26 - 4.7]	4	(D)	(D)	(D)
2011-12	ANNUAL	New Jersey	47	44	3	0	412	25.4 [19.6 - 31.8]	25.5 [17.8 - 33.2]	85.1	82.5	40	340	22.1 [16.3 - 28.6]	22.9 [26.2 - 4.1]	7	72	42.6 [27.2 - 58.9]	40 [29 - 10.9]
2011-12	ANNUAL	New Mexico	10	9	1	0	168	37.6 [29.8 - 45.9]	21.6 [5.7 - 37.4]	100.0	100.0	10	168	37.6 [29.8 - 45.9]	21.6 [25.5 - 8.1]	0			
2011-12	ANNUAL	New York	125	111	11	3	8,073	50.8 [47.8 - 53.8]	32.2 [27 - 37.4]	91.2	13.4	114	1,079	30.4 [26.8 - 34.1]	32.5 [30.5 - 2.9]	11	6,994	53.4 [44.2 - 62.5]	29.3 [20.2 - 6.1]
2011-12	ANNUAL	North Carolina	271	269	2	0	1,545	32.4 [29.4 - 35.4]	27.9 [24.6 - 31.3]	97.8	96.1	265	1,484	31.6 [28.5 - 34.7]	27.9 [28.5 - 1.8]	6	61	41.5 [27.6 - 56.4]	29 [26.5 - 10.8]
2011-12	ANNUAL	North Dakota	11	1	2	8	34,561	27.6 [22.8 - 32.8]	27.6 [17.6 - 37.7]	18.2	5.5	2	(D)	(D)	(D)	9	32,654	28.2 [22.9 - 33.9]	31.9 [15.2 - 5.1]
2011-12	ANNUAL	Ohio	147	139	6	2	2,513	33.9 [30.5 - 37.5]	29.7 [25 - 34.4]	97.3	57.5	143	1,445	40.7 [36.9 - 44.5]	29.9 [29.2 - 2.4]	4	(D)	(D)	(D)
2011-12	ANNUAL	Oklahoma	19	19	0	0	106	37.9 [25.5 - 51.5]	43.7 [29.3 - 58]	100.0	100.0	19	106	37.9 [25.5 - 51.5]	43.7 [31.9 - 7.3]	0			
2011-12	ANNUAL	Oregon	80	72	3	5	21,472	19.6 [17.7 - 21.6]	40.4 [32.5 - 48.3]	90.0	14.8	72	3,186	32.2 [30 - 34.4]	41.7 [37 - 4.4]	8	18,286	16.6 [12.9 - 20.9]	28.6 [23.9 - 8.5]
2011-12	ANNUAL	Pennsylvania	399	379	18	2	8,362	52.9 [51.3 - 54.5]	30.7 [27.5 - 33.9]	95.7	29.8	382	2,496	35.9 [33.3 - 38.6]	30.5 [32.5 - 1.7]	17	5,866	57.2 [53.2 - 61.2]	34.9 [22.5 - 5.5]
2011-12	ANNUAL	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	ANNUAL	Rhode Island	18	18	0	0	56	18.6 [10.2 - 29.6]	19.4 [7.1 - 31.7]	100.0	100.0	18	56	18.6 [10.2 - 29.6]	19.4 [26.7 - 6.3]	0			
2011-12	ANNUAL	South Carolina	61	58	3	0	1,155	28.3 [24.1 - 32.8]	33.5 [26.1 - 40.8]	95.1	38.5	58	445	33 [26.7 - 39.8]	34.2 [29.9 - 3.9]	3	(D)	(D)	(D)
2011-12	ANNUAL	South Dakota	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	ANNUAL	Tennessee	73	68	5	0	581	26.7 [23 - 30.7]	19.5 [14.8 - 24.2]	93.2	83.1	68	483	22.1 [18.4 - 26.1]	18.5 [20.7 - 2.5]	5	98	41.4 [35 - 48.1]	33.7 [12.7 - 5.7]
2011-12	ANNUAL	Texas	26	24	1	1	9,998	26.6 [24.4 - 28.8]	28.5 [16.6 - 40.4]	92.3	4.9	24	488	45.8 [37.6 - 54.3]	29.1 [32.1 - 6.5]	2	(D)	(D)	(D)
2011-12	ANNUAL	Utah	49	47	1	1	2,783	30.2 [28 - 32.6]	54.6 [45.7 - 63.6]	98.0	6.6	48	183	46.2 [38.4 - 54.1]	55.2 [32.2 - 4.6]	1	(D)	(D)	(D)
2011-12	ANNUAL	Vermont	51	48	2	1	1,134	18 [12.4 - 24.8]	37.7 [28.7 - 46.7]	92.2	21.6	47	245	39.5 [31.4 - 48]	37.7 [33.2 - 4.8]	4	(D)	(D)	(D)
2011-12	ANNUAL	Virginia	316	311	5	0	1,653	27.7 [25 - 30.6]	25.1 [22.1 - 28.2]	98.1	97.2	310	1,607	27.7 [24.9 - 30.6]	25.1 [28 - 1.6]	6	46	29.2 [12.5 - 50.8]	26.9 [23.1 - 9.4]
2011-12	ANNUAL	Washington	74	64	6	4	33,460	22.9 [21.2 - 24.7]	44.3 [36.8 - 51.9]	91.9	2.8	68	933	31.7 [26.6 - 37]	45.7 [34.2 - 4.1]	6	32,527	22.6 [17.5 - 28.3]	28.9 [11 - 4.5]
2011-12	ANNUAL	West Virginia	34	32	2	0	236	42.4 [33.7 - 51.5]	25.8 [17.2 - 34.4]	88.2	52.1	30	123	22.2 [15.7 - 29.9]	24.8 [25.9 - 4.7]	4	(D)	(D)	(D)
2011-12	ANNUAL	Wisconsin	78	77	1	0	459	36.5 [31.7 - 41.5]	40.9 [34.7 - 47]	96.2	96.3	75	442	37 [32.1 - 42.1]	41.4 [27.8 - 3.2]	3	(D)	(D)	(D)
2011-12	ANNUAL	Wyoming	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2011-12	ANNUAL	Other	0																
2011-12	ANNUAL	MultiStateOperation	90	39	24	27	94,867	31.7 [28.5 - 35.1]	30.1 [26.1 - 34.1]	0.0	0.0	90	94,867	31.7 [28.5 - 35.1]	30.1 [19.4 - 2]	90	94,867	31.7 [28.5 - 35.1]	30.1 [19.4 - 2]
2012-13	ANNUAL	Alabama	36	35	1	0	422	55.1 [45.3 - 64.6]	25.5 [16.5 - 34.6]	94.4	63.7	34	269	32.1 [25.5 - 39.2]	22.6 [25.6 - 4.4]	2	(D)	(D)	(D)
2012-13	ANNUAL	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	ANNUAL	Arizona	9	8	0	1	1,770	21.5 [18.8 - 24.3]	30.7 [11.9 - 49.4]	88.9	1.1	8	20	41 [24.8 - 58.8]	31.9 [30.5 - 10.8]	1	(D)	(D)	(D)
2012-13	ANNUAL	Arkansas	37	34	1	2	1,312	28.1 [25.7 - 30.6]	30.1 [20.9 - 39.2]	97.3	96.2	36	1,262	28.5 [26.1 - 31.1]	30.3 [28.7 - 4.8]	1	(D)	(D)	(D)
2012-13	ANNUAL	California	212	111	28	73	397,076	45.8 [43.4 - 48.3]	46.9 [43.3 - 50.5]	64.2	11.5	136	45,716	42.2 [38.4 - 46.1]	48.5 [30.4 - 2.6]	76	351,360	46.3 [42.4 - 50.3]	44.1 [19.6 - 2.2]
2012-13	ANNUAL	Colorado	165	162	3	0	816	51.3 [47.2 - 55.4]	43.6 [37.9 - 49.3]	97.6	82.5	161	673	51.4 [46.7 - 56]	43.5 [37.6 - 3]	4	(D)	(D)	(D)
2012-13	ANNUAL	Connecticut	57	54	3	0	517	57.6 [51.2 - 63.8]	55.3 [46.4 - 64.2]	91.2	68.3	52	353	62.4 [55.8 - 68.7]	55.7 [34 - 4.7]	5	164	47.3 [27.1 - 68.1]	50.9 [40 - 17.9]
2012-13	ANNUAL	District of Columbia	10	8	2	0	242	73.5 [68.4 - 78.2]	67.4 [48.5 - 86.4]	70.0	8.7	7	21	58.3 [35.8 - 78.7]	63.2 [36.4 - 13.8]	3	(D)	(D)	(D)
2012-13	ANNUAL	Delaware	23	19	2	2	11,817	48.2 [46 - 50.4]	48.4 [37.6 - 59.2]	82.6	1.0	19	117	62.7 [53 - 71.7]	48.9 [28.6 - 6.6]	4	(D)	(D)	(D)
2012-13	ANNUAL	Florida	95	70	11	14	45,053	42 [39.2 - 44.8]	33.4 [28.5 - 38.3]	78.9	10.2	75	4,616	25.9 [21.2 - 31]	31.8 [25.6 - 3]	20	40,437	43.4 [38.1 - 48.9]	39.4 [19.1 - 4.3]
2012-13	ANNUAL	Georgia	70	61	6	3	6,257	49 [44.1 - 53.9]	38.9 [31 - 46.8]	85.7	9.1	60	570	33 [25.9 - 40.7]	37.7 [35.5 - 4.6]	10	5,687	50.2 [37.8 - 62.7]	46.4 [20.4 - 6.5]
2012-13	ANNUAL	Hawaii	41	33	6	2	7,985	7.5 [3.9 - 12.6]	25 [17.3 - 32.8]	97.6	93.7	40	7,485	5.7 [2.7 - 10.3]	24.7 [25.6 - 4]	1	(D)	(D)	(D)
2012-13	ANNUAL	Idaho	30	16	3	11	57,892	36.2 [31.4 - 41.2]	49.8 [41.5 - 58.2]	50.0	1.8	15	1,042	26.2 [18.2 - 35.5]	57.9 [24.9 - 6.4]	15	56,850	36.3 [29.5 - 43.5]	41.8 [18.9 - 4.9]
2012-13	ANNUAL	Illinois	131	129	1	1	3,693	28.9 [25.6 - 32.4]	50.5 [44.3 - 56.7]	96.9	18.5	127	685	49.3 [43.8 - 54.8]	50.3 [36.3 - 3.2]	4	(D)	(D)	(D)
2012-13	ANNUAL	Indiana	108	104	3	1	2,625	27.1 [24.4 - 29.9]	40.6 [35.2 - 46]	96.3	26.8	104	704	35 [30.5 - 39.7]	40.8 [29 - 2.8]	4	(D)	(D)	(D)
2012-13	ANNUAL	Iowa	44	34	8	2	4,699	35 [28.8 - 41.6]	52.9 [44.8 - 61]	90.9	33.8	40	1,586	52.1 [44.5 - 59.7]	54.5 [28 - 4.4]	4	(D)	(D)	(D)
2012-13	ANNUAL	Kansas	39	33	5	1	1,382	41.6 [35.1 - 48.3]	41.4 [31.9 - 50.9]	87.2	22.7	34	314	40.6 [31.9 - 49.7]	42.3 [31.3 - 5.4]	5	1,068	41.8 [24.2 - 61]	35.6 [24.4 - 10.9]
2012-13	ANNUAL	Kentucky	46	43	3	0	421	44 [36.8 - 51.5]	55.6 [45.7 - 65.4]	93.5	91.2	43	384	45.5 [37.9 - 53.3]	56.6 [35 - 5.3]	3	(D)	(D)	(D)
2012-13	ANNUAL	Louisiana	13	12	1	0	488	41.2 [35.2 - 47.3]	23.8 [14.3 - 33.4]	100.0	100.0	13	488	41.2 [35.2 - 47.3]	23.8 [17.6 - 4.9]	0			
2012-13	ANNUAL	Maine	101	94	2	5	45,208	39.9 [38.2 - 41.6]	50.1 [43.9 - 56.2]	94.1	1.3	95	596	36.1 [31 - 41.4]	50.4 [32.3 - 3.3]	6	44,612	39.9 [32.9 - 47.3]	44.4 [11.9 - 4.9]
2012-13	ANNUAL	Maryland	181	173	6	2	12,839	49.4 [48.1 - 50.6]	60.1 [55.2 - 64.9]	95.0	7.0	172	905	63.6 [60.1 - 66.9]	60.4 [34.1 - 2.6]	9	11,934	48.5 [44.6 - 52.4]	54.5 [17.7 - 5.9]
2012-13	ANNUAL	Massachusetts	151	149	1	1	14,518	34.4 [33.2 - 35.6]	59.5 [54.2 - 64.7]	97.4	3.5	147	507	61.4 [57.1 - 65.6]	59.9 [32.7 - 2.7]	4	(D)	(D)	(D)
2012-13	ANNUAL	Michigan	205	189	11	5	22,462	41.5 [39.2 - 43.9]	62.6 [58 - 67.3]	96.6	9.8	198	2,200	66.7 [62.8 - 70.4]	63.2 [33.6 - 2.4]	7	20,262	38.9 [28.9 - 49.7]	47.2 [39 - 14.8]
2012-13	ANNUAL	Minnesota	74	61	2	11	45,182	57.5 [54.7 - 60.3]	71.3 [65.7 - 77]	83.8	21.3	62	9,645	64.7 [63.5 - 65.8]	73.7 [25 - 3.2]	12	35,537	54.6 [46.8 - 62.3]	59 [21.7 - 6.3]
2012-13	ANNUAL	Mississippi	26	18	4	4	108,558	60.2 [56.5 - 63.8]	37.7 [27.2 - 48.2]	80.8	0.7	21	776	37.7 [29.9 - 46]	36.3 [29.3 - 6.4]	5	107,782	60.4 [51.5 - 68.8]	43.3 [16.8 - 7.5]
2012-13	ANNUAL	Missouri	74	70	4	0	764	33.4 [28.4 - 38.7]	35.1 [28.9 - 41.4]	97.3	67.4	72	515	38.4 [33.6 - 43.3]	35.1 [27.5 - 3.2]	2	(D)	(D)	(D)
2012-13	ANNUAL	Montana	25	16	1	8	29,236	30.3 [21.3 - 40.4]	55.3 [43.9 - 66.8]	60.0	0.2	15	68	46.6 [27.8 - 66]	62.8 [29.5 - 7.6]	10	29,168	30.3 [16.4 - 47.1]	44.1 [26.4 - 8.3]
2012-13	ANNUAL	Nebraska	13	9	1	3	85,764	62.2 [55.6 - 68.5]	44.2 [28.6 - 59.9]	69.2	0.2	9	205	28.2 [12.1 - 49.4]	42.7 [31.9 - 10.6]	4	(D)	(D)	(D)
2012-13	ANNUAL	Nevada	4	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2012-13	ANNUAL	New Hampshire	57	55	2	0	511	36.5 [29.4 - 44]	52.9 [43 - 62.8]	100.0	100.0	57	511	36.5 [29.4 - 44]	52.9 [38.1 - 5]	0			
2012-13	ANNUAL	New Jersey	61	59	0	2	24,259	39.9 [38.1 - 41.8]	50 [41.4 - 58.7]	90.2	0.9	55	210	48.8 [40.6 - 57.1]	49.5 [35.5 - 4.8]	6	24,049	39.9 [34 - 45.9]	55.2 [22.1 - 9]
2012-13	ANNUAL	New Mexico	9	9	0	0	42	60.6 [39.7 - 79]	50.4 [27.5 - 73.3]	88.9	90.5	8	38	61.5 [38.4 - 81.6]	50.4 [37.5 - 13.3]	1	(D)	(D)	(D)
2012-13	ANNUAL	New York	176	156	10	10	38,288	41.5 [39.6 - 43.5]	48.8 [44.3 - 53.3]	91.5	7.3	161	2,783	48.3 [45.3 - 51.4]	49.3 [31.2 - 2.5]	15	35,505	41.1 [34.6 - 47.8]	44 [19.1 - 4.9]
2012-13	ANNUAL	North Carolina	275	269	5	1	3,569	46.8 [44.3 - 49.3]	49.7 [45.8 - 53.7]	96.7	67.0	266	2,393	44.2 [41.1 - 47.3]	49.8 [34 - 2.1]	9	1,176	51.2 [46.4 - 56]	47.4 [29.8 - 9.9]
2012-13	ANNUAL	North Dakota	34	4	1	29	182,556	42.2 [36.6 - 48.1]	48.8 [41.2 - 56.3]	8.8	0.0	3	(D)	(D)	(D)	31	182,544	42.2 [36.3 - 48.3]	44.9 [19.4 - 3.5]
2012-13	ANNUAL	Ohio	182	178	3	1	11,444	47.2 [46.2 - 48.3]	52.3 [47.5 - 57]	98.9	12.5	180	1,434	52.8 [49.6 - 56]	52.4 [32.9 - 2.5]	2	(D)	(D)	(D)
2012-13	ANNUAL	Oklahoma	29	26	2	1	3,632	65.4 [61.2 - 69.4]	34.5 [25.8 - 43.3]	93.1	8.8	27	320	46.9 [38.1 - 55.7]	34.2 [23.6 - 4.5]	2	(D)	(D)	(D)
2012-13	ANNUAL	Oregon	120	107	9	4	15,152	36.3 [34.2 - 38.6]	44.6 [38.5 - 50.6]	91.7	42.3	110	6,413	39.5 [37.5 - 41.5]	45.9 [34.5 - 3.3]	10	8,739	33.5 [25.6 - 42.1]	29.9 [21.7 - 6.9]
2012-13	ANNUAL	Pennsylvania	349	326	18	5	22,095	45.9 [44.4 - 47.4]	55.1 [51.6 - 58.6]	95.7	12.0	334	2,645	48.6 [45.6 - 51.6]	55.6 [34.1 - 1.9]	15	19,450	45.6 [39.4 - 52]	44.3 [17.7 - 4.6]
2012-13	ANNUAL	Puerto Rico	0																
2012-13	ANNUAL	Rhode Island	15	15	0	0	62	37.5 [27.7 - 48.1]	36.3 [21.5 - 51]	73.3	79.0	11	49	40.4 [26.7 - 55.1]	41.6 [31.3 - 9.4]	4	(D)	(D)	(D)
2012-13	ANNUAL	South Carolina	67	65	1	1	2,969	25.9 [22.1 - 29.9]	46.1 [38.9 - 53.3]	97.0	12.8	65	379	46.8 [41.3 - 52.4]	45.7 [29.6 - 3.7]	2	(D)	(D)	(D)
2012-13	ANNUAL	South Dakota	5	2	0	3	83,852	63.3 [56.6 - 69.7]	43.8 [23.6 - 64]	40.0	0.0	2	(D)	(D)	(D)	3	(D)	(D)	(D)
2012-13	ANNUAL	Tennessee	55	50	5	0	615	51.4 [44.2 - 58.6]	37.6 [29.4 - 45.8]	90.9	56.6	50	348	38.1 [31.2 - 45.3]	36.6 [31.3 - 4.4]	5	267	64.3 [41.9 - 83.2]	48.2 [27 - 12.1]
2012-13	ANNUAL	Texas	53	39	2	12	65,608	50.8 [46.9 - 54.7]	31.8 [24.3 - 39.4]	75.5	0.6	40	408	25.8 [19.1 - 33.4]	26.8 [29 - 4.6]	13	65,200	51 [42.9 - 59]	47.4 [17.8 - 4.9]
2012-13	ANNUAL	Utah	45	36	5	4	9,734	50.2 [43.2 - 57.2]	60.5 [52.5 - 68.5]	84.4	3.0	38	289	73.6 [67.4 - 79.2]	60.4 [27.9 - 4.5]	7	9,445	49.4 [31.2 - 67.6]	60.8 [25.6 - 9.7]
2012-13	ANNUAL	Vermont	39	34	2	3	2,854	29.9 [26.3 - 33.6]	45.8 [36 - 55.6]	89.7	45.0	35	1,285	31.4 [27.5 - 35.4]	45.7 [31.8 - 5.4]	4	(D)	(D)	(D)
2012-13	ANNUAL	Virginia	467	455	10	2	14,462	48 [46.9 - 49.1]	49.5 [46.4 - 52.6]	97.6	18.5	456	2,672	48.4 [45.8 - 51]	49.5 [33.8 - 1.6]	11	11,790	47.9 [44.3 - 51.5]	48.6 [30.8 - 9.3]
2012-13	ANNUAL	Washington	107	95	5	7	48,969	43.4 [41.5 - 45.3]	51.7 [45.2 - 58.3]	89.7	1.4	96	662	44.5 [39.5 - 49.6]	52.9 [35.8 - 3.7]	11	48,307	43.4 [37.6 - 49.3]	41.2 [17 - 5.1]
2012-13	ANNUAL	West Virginia	60	58	1	1	2,124	55.8 [51.2 - 60.3]	41.3 [33.2 - 49.5]	93.3	19.1	56	406	33.8 [27.1 - 41]	40.4 [32.4 - 4.3]	4	(D)	(D)	(D)
2012-13	ANNUAL	Wisconsin	127	110	12	5	19,097	43.7 [41.1 - 46.3]	67.4 [62.4 - 72.4]	92.9	13.6	118	2,588	65.9 [61.3 - 70.4]	68.7 [28.2 - 2.6]	9	16,509	40.8 [34.3 - 47.5]	49.5 [30.1 - 10]
2012-13	ANNUAL	Wyoming	13	7	2	4	13,370	46.4 [32.1 - 61]	38.7 [22.9 - 54.4]	53.8	0.7	7	98	18.5 [8.7 - 32]	26.6 [28.1 - 10.6]	6	13,272	46.6 [25.4 - 68.7]	52.7 [25.3 - 10.3]
2012-13	ANNUAL	Other	0																
2012-13	ANNUAL	MultiStateOperation	156	47	36	73	386,054	46.5 [43.7 - 49.3]	45.4 [41.7 - 49.1]	0.0	0.0	156	386,054	46.5 [43.7 - 49.3]	45.4 [23.6 - 1.9]	156	386,054	46.5 [43.7 - 49.3]	45.4 [23.6 - 1.9]
2013-14	ANNUAL	Alabama	33	32	1	0	572	44.3 [40.4 - 48.3]	31.7 [24.7 - 38.7]	93.9	38.6	31	221	35.7 [29.7 - 42.1]	30.1 [19.9 - 3.6]	2	(D)	(D)	(D)
2013-14	ANNUAL	Alaska	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2013-14	ANNUAL	Arizona	5	4	1	0	203	48.5 [34.8 - 62.3]	29.3 [-9.6 - 68.2]	80.0	97.0	4	(D)	(D)	(D)	1	(D)	(D)	(D)
2013-14	ANNUAL	Arkansas	56	51	3	2	6,675	29.4 [26.7 - 32.1]	41.8 [33.7 - 50]	92.9	6.0	52	402	58.6 [52 - 65]	43.3 [31.9 - 4.4]	4	(D)	(D)	(D)
2013-14	ANNUAL	California	253	156	27	70	288,167	31.7 [30.1 - 33.4]	41.8 [38.1 - 45.6]	65.6	4.3	166	12,396	36 [33.7 - 38.3]	46.8 [34.2 - 2.7]	87	275,771	31.5 [28.7 - 34.4]	32.4 [18.9 - 2]
2013-14	ANNUAL	Colorado	174	172	1	1	42,707	27.1 [26.5 - 27.6]	44.9 [39.5 - 50.3]	97.7	1.4	170	612	41.5 [37.2 - 45.9]	45.5 [36.4 - 2.8]	4	(D)	(D)	(D)
2013-14	ANNUAL	Connecticut	65	63	2	0	1,293	81.6 [73.5 - 88.1]	54.3 [45.7 - 63]	90.8	18.2	59	235	46.1 [38.6 - 53.7]	54.5 [35.9 - 4.7]	6	1,058	93.3 [65.6 - 99.9]	52.4 [33.9 - 13.8]
2013-14	ANNUAL	District of Columbia	6	5	1	0	110	85.7 [68.7 - 95.7]	38.5 [2.6 - 74.3]	66.7	14.5	4	(D)	(D)	(D)	2	(D)	(D)	(D)
2013-14	ANNUAL	Delaware	21	20	0	1	12,094	42.9 [42.1 - 43.6]	43.4 [31 - 55.8]	76.2	0.5	16	60	43.6 [32.1 - 55.6]	43.9 [31.2 - 7.8]	5	12,034	42.8 [41.9 - 43.8]	41.7 [23.4 - 10.5]
2013-14	ANNUAL	Florida	150	122	8	20	50,250	36 [33.4 - 38.6]	35.9 [31.3 - 40.6]	80.7	6.5	121	3,242	37.8 [34.9 - 40.7]	36 [30.6 - 2.8]	29	47,008	35.9 [30.1 - 41.9]	35.8 [23.3 - 4.3]

SurveyYear	Season	State	All operations in the State N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	Exclusive to the State N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Multi-State operations N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2013-14	ANNUAL	Georgia	92	82	4	6	9,916	44.5 [40.2 - 48.9]	41 [34 - 48.1]	87.0	12.0	80	1,189	26.6 [21.7 - 31.8]	39.6 [35.1 - 3.9]	12	8,727	46.2 [34.5 - 58.2]	50.5 [27.4 - 7.9]
2013-14	ANNUAL	Hawaii	67	60	4	3	11,804	24.9 [21.9 - 28.1]	26.5 [20 - 33]	98.5	53.4	66	6,304	21.7 [17.5 - 26.4]	26.5 [27.2 - 3.3]	1	(D)	(D)	(D)
2013-14	ANNUAL	Idaho	34	16	2	16	81,574	27.8 [24.2 - 31.5]	34 [26.1 - 42]	55.9	7.4	19	6,050	16.1 [14 - 18.4]	40.4 [28.7 - 6.6]	15	75,524	28.7 [23.4 - 34.4]	26 [11.4 - 2.9]
2013-14	ANNUAL	Illinois	125	123	1	1	971	63.1 [60.2 - 66]	65.8 [60.3 - 71.2]	96.8	68.0	121	660	66.2 [61.7 - 70.6]	65.6 [31.4 - 2.9]	4	(D)	(D)	(D)
2013-14	ANNUAL	Indiana	174	168	5	1	2,883	40.9 [36.2 - 45.7]	68.4 [63.7 - 73.1]	96.0	42.3	167	1,220	71.1 [66.9 - 75.1]	68.9 [31.8 - 2.5]	7	1,663	18.4 [12.6 - 25.3]	54.8 [31 - 11.7]
2013-14	ANNUAL	Iowa	55	51	4	0	818	70.5 [62.7 - 77.7]	59.2 [51.1 - 67.3]	96.4	88.5	53	724	76.5 [69.5 - 82.7]	60.2 [30.8 - 4.2]	2	(D)	(D)	(D)
2013-14	ANNUAL	Kansas	38	36	2	0	365	50.1 [41.2 - 58.9]	41.6 [32.7 - 50.5]	97.4	74.0	37	270	36.3 [29 - 44]	40.6 [27.6 - 4.5]	1	(D)	(D)	(D)
2013-14	ANNUAL	Kentucky	94	89	5	0	1,086	44.9 [40.1 - 49.7]	50.5 [43.8 - 57.1]	95.7	74.3	90	807	47.7 [43 - 52.5]	50.1 [32.9 - 3.5]	4	(D)	(D)	(D)
2013-14	ANNUAL	Louisiana	20	18	0	2	7,769	30.3 [27.9 - 32.7]	32.3 [21.2 - 43.3]	95.0	29.2	19	2,269	39 [36.4 - 41.6]	32.5 [25.9 - 5.9]	1	(D)	(D)	(D)
2013-14	ANNUAL	Maine	140	134	2	4	27,159	41.2 [38.8 - 43.7]	47 [41.3 - 52.8]	95.7	2.3	134	620	40.9 [36.8 - 45]	46.9 [35 - 3]	6	26,539	41.2 [29.2 - 53.9]	48.9 [23.7 - 9.7]
2013-14	ANNUAL	Maryland	148	143	3	2	13,234	43.8 [42.4 - 45.1]	50.6 [45.2 - 56]	91.9	8.1	136	1,066	46.8 [43.3 - 50.4]	50.9 [34 - 2.9]	12	12,168	43.5 [39.8 - 47.3]	46.6 [30.8 - 8.9]
2013-14	ANNUAL	Massachusetts	145	141	2	2	7,455	25.7 [23.4 - 28.1]	55.1 [49.2 - 60.9]	95.2	18.1	138	1,352	38.4 [33.8 - 43.1]	56.6 [36.1 - 3.1]	7	6,103	22.3 [21.4 - 23.2]	25 [12.7 - 4.8]
2013-14	ANNUAL	Michigan	332	314	9	9	20,094	41.7 [39.5 - 43.9]	72.5 [69.1 - 75.8]	96.4	12.6	320	2,522	63.4 [60.6 - 66]	73.4 [30.9 - 1.7]	12	17,572	37.9 [28.3 - 48.1]	46.9 [25.5 - 7.4]
2013-14	ANNUAL	Minnesota	93	77	6	10	69,239	30.1 [28 - 32.2]	64 [57 - 71]	86.0	1.8	80	1,269	57.8 [53 - 62.5]	68.5 [33.6 - 3.8]	13	67,970	29.4 [24.5 - 34.6]	36.4 [25.7 - 7.1]
2013-14	ANNUAL	Mississippi	23	15	2	6	70,577	37.9 [31.6 - 44.5]	35.2 [24.8 - 45.5]	65.2	0.2	15	172	26.8 [17 - 38.6]	30.9 [25.8 - 6.7]	8	70,405	37.9 [27.1 - 49.6]	43.1 [23.9 - 8.4]
2013-14	ANNUAL	Missouri	78	75	3	0	923	41.5 [36.5 - 46.5]	40.1 [33.2 - 47]	98.7	89.2	77	823	38.6 [33.5 - 43.9]	39.9 [31.4 - 3.6]	1	(D)	(D)	(D)
2013-14	ANNUAL	Montana	23	17	1	5	25,793	21.6 [18 - 25.5]	35.3 [22.4 - 48.3]	69.6	0.2	16	53	38.7 [27.7 - 50.5]	39.2 [36.5 - 9.1]	7	25,740	21.5 [15 - 29.1]	26.5 [14.2 - 5.4]
2013-14	ANNUAL	Nebraska	11	8	1	2	53,652	26.5 [23.7 - 29.4]	61.2 [42.2 - 80.2]	72.7	0.1	8	37	56.8 [39.5 - 73]	66.2 [29.9 - 10.6]	3	(D)	(D)	(D)
2013-14	ANNUAL	Nevada	12	10	2	0	424	35.1 [26.1 - 44.9]	41 [21.4 - 60.6]	83.3	8.7	10	37	47.3 [25.8 - 69.5]	41.5 [38 - 12]	2	(D)	(D)	(D)
2013-14	ANNUAL	New Hampshire	57	57	0	0	174	60.8 [52.1 - 69]	60.8 [51 - 70.6]	96.5	89.7	55	156	62.7 [53.8 - 71.1]	61.6 [38.1 - 5.1]	2	(D)	(D)	(D)
2013-14	ANNUAL	New Jersey	165	158	5	2	16,937	39.7 [38.3 - 41.2]	42.7 [37.4 - 48]	96.4	5.1	159	869	45 [41 - 49.1]	42.4 [35 - 2.8]	6	16,068	39.5 [32.8 - 46.3]	50.3 [22.6 - 9.2]
2013-14	ANNUAL	New Mexico	18	18	0	0	59	32.5 [20.1 - 46.8]	33.6 [17.7 - 49.5]	100.0	100.0	18	59	32.5 [20.1 - 46.8]	33.6 [34.4 - 8.1]	0			
2013-14	ANNUAL	New York	161	145	11	5	19,425	45.6 [42.9 - 48.3]	54 [49 - 59]	93.8	10.3	151	1,996	55.5 [51.2 - 59.8]	54 [32.9 - 2.7]	10	17,429	44.5 [34.7 - 54.5]	53.3 [27.2 - 8.6]
2013-14	ANNUAL	North Carolina	241	234	5	2	44,979	27.7 [26.9 - 28.5]	44.5 [40.3 - 48.7]	93.8	3.4	226	1,518	45.8 [41.7 - 50]	45.4 [33.6 - 2.2]	15	43,461	27.1 [26 - 28.3]	30.3 [21.3 - 5.5]
2013-14	ANNUAL	North Dakota	26	1	2	23	128,819	37.4 [31.3 - 43.7]	33.6 [26.6 - 40.6]	3.8	0.0	1	(D)	(D)	(D)	25	128,818	37.4 [31.2 - 43.8]	34.9 [17.2 - 3.4]
2013-14	ANNUAL	Ohio	407	403	3	1	14,089	45.8 [44.5 - 47]	60.5 [57.2 - 63.9]	97.5	13.3	397	1,876	61.6 [58.8 - 64.4]	60.6 [34.5 - 1.7]	10	12,213	43.2 [40.7 - 45.7]	59 [23 - 7.3]
2013-14	ANNUAL	Oklahoma	26	25	0	1	4,718	42.7 [40.5 - 44.8]	35.2 [22.5 - 47.9]	96.2	2.5	25	118	21.9 [12.3 - 34]	34.9 [33.7 - 6.7]	1	(D)	(D)	(D)
2013-14	ANNUAL	Oregon	173	161	3	9	34,967	32.5 [30.4 - 34.7]	43.8 [38.5 - 49.1]	91.9	1.6	159	544	48.3 [43.7 - 52.9]	44.9 [36.4 - 2.9]	14	34,423	32.2 [25.1 - 40]	31.3 [20.6 - 5.5]
2013-14	ANNUAL	Pennsylvania	828	809	16	3	20,925	45.8 [44.5 - 47]	54.5 [52 - 56.9]	97.9	20.7	811	4,328	49.2 [47.2 - 51.2]	54.5 [36.2 - 1.3]	17	16,597	45 [37.5 - 52.6]	55.4 [28.3 - 6.9]
2013-14	ANNUAL	Puerto Rico	0																
2013-14	ANNUAL	Rhode Island	22	21	1	0	119	37.4 [27.8 - 47.7]	43.1 [28.5 - 57.7]	72.7	52.9	16	63	34.6 [18.2 - 53.9]	45.8 [40 - 10]	6	56	39.1 [32 - 46.5]	35.8 [16.2 - 6.6]
2013-14	ANNUAL	South Carolina	140	135	4	1	1,867	34.5 [31.3 - 37.8]	38 [32.7 - 43.3]	96.4	48.7	135	909	35.8 [31.6 - 40.1]	38.2 [32.4 - 2.8]	5	958	32.8 [26.3 - 39.8]	30.8 [23.2 - 10.4]
2013-14	ANNUAL	South Dakota	14	8	1	5	53,710	30.4 [24 - 37.4]	55.6 [40.2 - 70.9]	50.0	0.0	7	22	41.2 [23.7 - 60.3]	58.5 [34 - 12.8]	7	53,688	30.4 [21.2 - 40.8]	52.6 [26.1 - 9.9]
2013-14	ANNUAL	Tennessee	91	87	4	0	1,005	41.4 [37.5 - 45.4]	42 [35.4 - 48.7]	94.5	54.4	86	547	38.9 [33.7 - 44.4]	41.9 [32.4 - 3.5]	5	458	43.8 [35.3 - 52.7]	43.6 [33.7 - 15.1]
2013-14	ANNUAL	Texas	78	55	7	16	112,384	35.7 [32 - 39.6]	34.2 [28.3 - 40.1]	75.6	2.3	59	2,622	55 [51.3 - 58.6]	32.8 [26.4 - 3.4]	19	109,762	35.1 [27.6 - 43.1]	38.7 [26.8 - 6.2]
2013-14	ANNUAL	Utah	51	43	5	3	4,402	28.7 [24.5 - 33]	43.3 [34.6 - 52]	82.4	3.9	42	171	38.5 [29.5 - 47.9]	44.2 [32.9 - 5.1]	9	4,231	28.4 [19 - 39.2]	39.2 [26.7 - 8.9]
2013-14	ANNUAL	Vermont	82	79	2	1	1,317	53.8 [50.6 - 56.9]	56.6 [49.4 - 63.9]	95.1	98.2	78	1,293	53.6 [50.4 - 56.8]	56.4 [33.6 - 3.8]	4	(D)	(D)	(D)
2013-14	ANNUAL	Virginia	637	623	13	1	15,980	42.3 [41.4 - 43.3]	43 [40.4 - 45.6]	98.1	23.5	625	3,751	41.6 [39.5 - 43.6]	43.2 [33.9 - 1.4]	12	12,229	42.6 [40.8 - 44.4]	33.3 [35 - 10.1]
2013-14	ANNUAL	Washington	119	102	9	8	44,938	35.4 [32.8 - 38.1]	41.7 [36 - 47.4]	89.1	1.6	106	716	42 [36.7 - 47.5]	42.9 [32.9 - 3.2]	13	44,222	35.3 [27.7 - 43.5]	32 [16.3 - 4.5]
2013-14	ANNUAL	West Virginia	65	60	5	0	867	44.8 [37.8 - 52]	43.9 [35.8 - 52]	90.8	63.4	59	550	55.1 [47.7 - 62.4]	45 [34.1 - 4.4]	6	317	22.9 [11.4 - 38.1]	33.3 [23.5 - 9.6]
2013-14	ANNUAL	Wisconsin	136	112	13	11	37,321	33.8 [31.3 - 36.4]	64.9 [59.5 - 70.4]	86.0	3.4	117	1,263	63.1 [58.3 - 67.7]	69.5 [31.3 - 2.9]	19	36,058	32.5 [26.7 - 38.6]	36.6 [25.2 - 5.8]
2013-14	ANNUAL	Wyoming	10	5	1	4	14,184	20.1 [14.5 - 26.6]	42 [23.4 - 60.7]	40.0	0.1	4	(D)	(D)	(D)	6	14,171	20.1 [12.8 - 28.9]	36.7 [29.2 - 11.9]
2013-14	ANNUAL	Other	0																
2013-14	ANNUAL	MultiStateOperation	185	72	37	76	314,664	33.6 [31.3 - 35.9]	39.9 [36.2 - 43.7]	0.0	0.0	185	314,664	33.6 [31.3 - 35.9]	39.9 [26.1 - 1.9]	185	314,664	33.6 [31.3 - 35.9]	39.9 [26.1 - 1.9]
2014-15	ANNUAL	Alabama	28	27	1	0	268	48 [38.6 - 57.6]	40.6 [30.6 - 50.7]	96.4	98.5	27	264	48.6 [38.9 - 58.3]	41.2 [27.4 - 5.3]	1	(D)	(D)	(D)
2014-15	ANNUAL	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2014-15	ANNUAL	Arizona	9	7	1	1	424	58.8 [48.6 - 68.6]	39.2 [12.6 - 65.7]	88.9	62.3	8	264	42.9 [32 - 54.4]	35.7 [42 - 14.8]	1	(D)	(D)	(D)
2014-15	ANNUAL	Arkansas	96	92	3	1	1,927	48.3 [45 - 51.6]	36.5 [30.5 - 42.6]	93.8	75.9	90	1,462	48.6 [45.4 - 51.7]	36.9 [30.9 - 3.3]	6	465	47.4 [31 - 64.2]	30.8 [20.6 - 8.4]
2014-15	ANNUAL	California	183	112	19	52	263,882	38.2 [35.5 - 40.9]	37.7 [33.6 - 41.9]	63.4	12.5	116	32,932	25.5 [23 - 28.2]	37.2 [32 - 3]	67	230,950	39.6 [35.3 - 44.1]	38.7 [21.9 - 2.7]
2014-15	ANNUAL	Colorado	178	176	1	1	44,653	38 [37.4 - 38.6]	52.6 [47.1 - 58.1]	97.8	1.4	174	629	52.7 [48.1 - 57.3]	52.6 [37.8 - 2.9]	4	(D)	(D)	(D)
2014-15	ANNUAL	Connecticut	56	54	2	0	334	57.3 [49.8 - 64.5]	56.7 [47.8 - 65.5]	94.6	65.9	53	220	66.1 [58.6 - 73.1]	57.3 [34.2 - 4.7]	3	(D)	(D)	(D)
2014-15	ANNUAL	District of Columbia	3	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2014-15	ANNUAL	Delaware	16	13	1	2	18,291	61 [59.6 - 62.5]	48.1 [33.4 - 62.9]	62.5	0.2	10	31	50.7 [36.5 - 64.8]	43.8 [34.2 - 10.8]	6	18,260	61.1 [58.7 - 63.4]	55.4 [22.4 - 9.2]
2014-15	ANNUAL	Florida	93	72	15	6	27,513	55.3 [52.2 - 58.4]	36.4 [30.4 - 42.3]	86.0	8.0	80	2,189	50.4 [45 - 55.8]	35.3 [30.2 - 3.4]	13	25,324	55.7 [47.6 - 63.6]	42.9 [21.1 - 5.9]
2014-15	ANNUAL	Georgia	74	65	7	2	4,347	34.9 [30.4 - 39.6]	49.3 [41.7 - 57]	86.5	27.4	64	1,192	40.2 [32.3 - 48.5]	50.2 [34.5 - 4.3]	10	3,155	32.5 [27 - 38.4]	43.6 [28.5 - 9]
2014-15	ANNUAL	Hawaii	28	20	4	4	8,696	13.9 [8 - 21.6]	21.2 [13.3 - 29.1]	100.0	100.0	28	8,696	13.9 [8 - 21.6]	21.2 [21.3 - 4]	0			
2014-15	ANNUAL	Idaho	48	34	1	13	62,999	27.7 [23 - 32.7]	38 [29.5 - 46.5]	70.8	0.2	34	135	36.9 [27.3 - 47.3]	41.6 [34 - 5.8]	14	62,864	27.6 [19.1 - 37.4]	29.3 [15.6 - 4.2]
2014-15	ANNUAL	Illinois	102	101	1	0	747	62.4 [57.3 - 67.3]	60.1 [53.3 - 66.9]	97.1	56.9	99	425	59.3 [53.2 - 65.3]	60.2 [35.5 - 3.6]	3	(D)	(D)	(D)
2014-15	ANNUAL	Indiana	92	92	0	0	345	48.5 [43.2 - 53.8]	45.5 [39.1 - 51.9]	96.7	96.8	89	334	48.5 [43.1 - 53.9]	44.9 [31.2 - 3.3]	3	(D)	(D)	(D)
2014-15	ANNUAL	Iowa	36	33	3	0	569	61.4 [51 - 71.1]	59.2 [51.1 - 67.2]	94.4	63.1	34	359	75.1 [67.3 - 81.9]	60.7 [24.2 - 4.2]	2	(D)	(D)	(D)
2014-15	ANNUAL	Kansas	39	37	2	0	906	42.4 [35 - 49.9]	44.9 [33.8 - 56.1]	97.4	85.1	38	771	50.1 [44.3 - 56]	45.9 [35.5 - 5.8]	1	(D)	(D)	(D)
2014-15	ANNUAL	Kentucky	59	57	2	0	476	47.9 [41.7 - 54.1]	54.4 [46.5 - 62.4]	98.3	74.8	58	356	52.9 [46.1 - 59.6]	54.8 [31.4 - 4.1]	1	(D)	(D)	(D)
2014-15	ANNUAL	Louisiana	18	16	1	1	2,913	44.3 [40.6 - 48]	43.2 [31 - 55.5]	83.3	12.2	15	355	29.3 [21.5 - 38]	41.8 [27.4 - 7.1]	3	(D)	(D)	(D)
2014-15	ANNUAL	Maine	103	99	2	2	18,582	60.5 [59.7 - 61.4]	53.4 [46.9 - 59.8]	96.1	2.3	99	422	42.7 [36.7 - 48.7]	53.5 [33.9 - 3.4]	4	(D)	(D)	(D)
2014-15	ANNUAL	Maryland	126	123	2	1	9,751	60.9 [59.8 - 62]	52.8 [47.5 - 58.2]	94.4	4.8	119	464	50.8 [46.1 - 55.6]	52.2 [31 - 2.8]	7	9,287	61.2 [58.3 - 64]	62.9 [20 - 7.5]
2014-15	ANNUAL	Massachusetts	150	146	4	0	783	46.1 [40.8 - 51.5]	55.9 [50.4 - 61.4]	98.0	78.0	147	611	54.4 [49 - 59.7]	56.2 [34.2 - 2.8]	3	(D)	(D)	(D)
2014-15	ANNUAL	Michigan	210	202	7	1	8,068	31.8 [28.6 - 35.1]	53.9 [49.5 - 58.3]	98.1	92.9	206	7,497	27.1 [24.7 - 29.6]	53.8 [32.5 - 2.3]	4	(D)	(D)	(D)
2014-15	ANNUAL	Minnesota	77	64	5	8	64,656	50.6 [45.5 - 55.7]	63.4 [56.6 - 70.1]	80.5	0.4	62	255	62.2 [55.6 - 68.5]	67.1 [29.3 - 3.7]	15	64,401	50.6 [38.8 - 62.2]	47.9 [29.9 - 7.7]
2014-15	ANNUAL	Mississippi	11	8	1	2	12,757	38.7 [35.1 - 42.3]	45.2 [29.9 - 60.6]	81.8	1.2	9	157	51.7 [40.9 - 62.4]	47.1 [28.6 - 9.5]	2	(D)	(D)	(D)
2014-15	ANNUAL	Missouri	94	88	6	0	1,135	34.8 [30.1 - 39.7]	44.9 [39.1 - 50.8]	96.8	97.0	91	1,101	35.3 [30.4 - 40.3]	45.8 [29.1 - 3.1]	3	(D)	(D)	(D)
2014-15	ANNUAL	Montana	26	18	1	7	28,858	40.1 [30.4 - 50.3]	43.1 [30.3 - 56]	73.1	6.1	19	1,769	37.6 [33.7 - 41.6]	45 [35.1 - 8]	7	27,089	40.2 [21.3 - 61.4]	37.9 [30.4 - 11.5]
2014-15	ANNUAL	Nebraska	12	10	0	2	52,112	37.3 [36 - 38.6]	52.4 [35.3 - 69.5]	75.0	0.1	9	67	44.5 [25.4 - 64.9]	51.6 [31.3 - 10.4]	3	(D)	(D)	(D)
2014-15	ANNUAL	Nevada	8	6	1	1	1,447	26.7 [18.7 - 35.9]	56.7 [31.2 - 82.1]	62.5	1.9	5	28	69.4 [43.6 - 88.8]	74.2 [30 - 13.4]	3	(D)	(D)	(D)
2014-15	ANNUAL	New Hampshire	42	41	1	0	204	39.4 [31.8 - 47.2]	56.6 [45.4 - 67.8]	90.5	63.2	38	129	46.5 [36.6 - 56.6]	57.4 [36.9 - 6]	4	(D)	(D)	(D)
2014-15	ANNUAL	New Jersey	93	92	1	0	475	48.2 [42.3 - 54.1]	41 [34.2 - 47.9]	95.7	84.8	89	403	40 [34.9 - 45.4]	40.4 [33.9 - 3.6]	4	(D)	(D)	(D)
2014-15	ANNUAL	New Mexico	21	20	0	1	1,586	46.1 [42.8 - 49.5]	35.1 [20.4 - 49.8]	95.2	5.4	20	86	29.2 [19.5 - 40.4]	34.5 [35.2 - 7.9]	1	(D)	(D)	(D)
2014-15	ANNUAL	New York	146	131	9	6	24,548	54.2 [51.6 - 56.8]	45.2 [40 - 50.4]	93.8	8.8	137	2,148	30.9 [27.5 - 34.4]	45 [32 - 2.7]	9	22,400	55.8 [45.8 - 65.5]	47.5 [33.8 - 11.3]
2014-15	ANNUAL	North Carolina	254	250	4	0	1,803	41.6 [38.3 - 45]	43.2 [39.4 - 47.1]	97.2	97.6	247	1,759	41.4 [38 - 44.9]	43 [31.6 - 2]	7	44	47.8 [35.4 - 60.5]	51 [25.3 - 9.6]
2014-15	ANNUAL	North Dakota	30	4	2	24	154,607	37.7 [32.6 - 43]	39 [31.5 - 46.5]	6.7	0.0	2	(D)	(D)	(D)	28	154,601	37.7 [32.4 - 43.2]	39.2 [19.2 - 3.6]
2014-15	ANNUAL	Ohio	270	264	6	0	1,930	59.1 [55.1 - 63.1]	51.8 [47.5 - 56.1]	97.4	71.2	263	1,374	50.6 [46.5 - 54.6]	51.5 [36.3 - 2.2]	7	556	87 [75.5 - 94.5]	65.9 [25.6 - 9.7]
2014-15	ANNUAL	Oklahoma	36	32	1	3	8,019	63.4 [61.3 - 65.5]	44.2 [34 - 54.3]	88.9	3.0	32	237	49.9 [39.4 - 60.3]	42.8 [32.6 - 5.8]	4	(D)	(D)	(D)
2014-15	ANNUAL	Oregon	142	134	1	7	29,999	25.2 [22.7 - 27.8]	36.6 [31.4 - 41.9]	94.4	29.3	134	8,778	33.4 [30.7 - 36.2]	37.3 [31.9 - 2.8]	8	21,221	19.7 [12.1 - 29.2]	25.2 [28.4 - 10]
2014-15	ANNUAL	Pennsylvania	674	660	12	2	22,004	61.1 [60.3 - 61.9]	58.4 [55.9 - 60.9]	98.7	15.5	665	3,412	59.2 [57 - 61.3]	58.3 [33.5 - 1.3]	9	18,592	61.4 [58.5 - 64.1]	64 [20.5 - 6.8]
2014-15	ANNUAL	Puerto Rico	0																
2014-15	ANNUAL	Rhode Island	22	20	2	0	193	47.9 [36.6 - 59.3]	49.5 [35.3 - 63.8]	72.7	36.8	16	71	49.5 [36.4 - 62.7]	46.1 [31.5 - 7.9]	6	122	47.3 [25.3 - 70.1]	58.5 [41.9 - 17.1]
2014-15	ANNUAL	South Carolina	71	67	3	1	1,874	26.2 [22.1 - 30.6]	42.3 [35.1 - 49.5]	88.7	20.3	63	381	40.4 [34.3 - 46.7]	43 [31.2 - 3.9]	8	1,493	21.8 [13.6 - 31.9]	37.1 [31.5 - 11.1]
2014-15	ANNUAL	South Dakota	15	8	0	7	55,634	36.1 [31.6 - 40.8]	37.4 [21.9 - 52.9]	46.7	0.0	7	17	42.3 [21.4 - 65.3]	29.6 [36.9 - 13.9]	8	55,617	36.1 [29.8 - 42.8]	44.2 [24.5 - 8.7]
2014-15	ANNUAL	Tennessee	73	67	6	0	1,034	36.3 [31.5 - 41.3]	46.3 [38.7 - 53.8]	95.9	74.1	70	766	33.8 [28.4 - 39.6]	46.1 [33.4 - 4]	3	(D)	(D)	(D)
2014-15	ANNUAL	Texas	139	121	3	15	94,994	46.3 [42.9 - 49.7]	29.6 [24.8 - 34.5]	85.6	3.2	119	3,021	49.2 [46.4 - 52]	27.1 [29.6 - 2.7]	20	91,973	46.2 [37 - 55.5]	44.9 [21.2 - 4.7]
2014-15	ANNUAL	Utah	41	34	3	4	13,851	33.6 [31.7 - 35.5]	49.5 [40.4 - 58.6]	82.9	1.1	34	147	57.8 [48.4 - 66.7]	51.1 [32 - 5.5]	7	13,704	33.3 [29.6 - 37.2]	41.7 [12.1 - 4.6]
2014-15	ANNUAL	Vermont	50	46	4	0	360	34.1 [27.9 - 40.6]	36.3 [26.7 - 45.8]	92.0	72.2	46	260	31.6 [24 - 40]	36.3 [35.2 - 5.2]	4	(D)	(D)	(D)
2014-15	ANNUAL	Virginia	590	582	8	0	2,855	46.1 [43.7 - 48.4]	48.2 [45.4 - 51]	98.5	98.1	581	2,801	46.1 [43.7 - 48.5]	48.2 [35.2 - 1.5]	9	54	45.3 [34.9 - 56.1]	48.2 [14.6 - 4.9]
2014-15	ANNUAL	Washington	128	116	2	10	86,503	39.3 [36.7 - 42]	52.2 [46.4 - 58]	91.4	0.7	117	585	40.6 [35.5 - 45.7]	52.8 [33.9 - 3.1]	11	85,918	39.3 [30.4 - 48.8]	46.1 [30.4 - 9.2]
2014-15	ANNUAL	West Virginia	47	46	1	0	468	60.9 [51.2 - 69.9]	39.2 [30 - 48.3]	87.2	40.0	41	187	31.6 [23.7 - 40.2]	36.1 [32.1 - 5]	6	281	80.4 [61.6 - 92.9]	60.2 [24.7 - 10.1]
2014-15	ANNUAL	Wisconsin	124	110	11	3	20,903	60.2 [58.8 - 61.5]	62.7 [56.9 - 68.6]	92.7	7.9	115	1,643	56.6 [51.4 - 61.7]	63.7 [33.8 - 3.1]	9	19,260	60.4 [57.7 - 63.1]	50.2 [25.8 - 8.6]
2014-15	ANNUAL	Wyoming	11	7	0	4	12,722	32.5 [23.9 - 42.1]	52.9 [36.5 - 69.3]	63.6	0.2	7	22	47.5 [29.7 - 65.7]	62.5 [27.4 - 10.3]	4	(D)	(D)	(D)
2014-15	ANNUAL	Other	0																
2014-15	ANNUAL	MultiStateOperation	145	62	30	53	246,407	42.5 [39.1 - 46.1]	44.5 [40.3 - 48.8]	0.0	0.0	145	246,407	42.5 [39.1 - 46.1]	44.5 [25.9 - 2.2]	145	246,407	42.5 [39.1 - 46.1]	44.5 [25.9 - 2.2]
2015-16	ANNUAL	Alabama	43	43	0	0	362	28.4 [21 - 36.8]	27.2 [19 - 35.4]	97.7	96.4	42	349	26.9 [19.6 - 35.3]	26.3 [27.3 - 4.2]	1	(D)	(D)	(D)
2015-16	ANNUAL	Alaska	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2015-16	ANNUAL	Arizona	6	6	0	0	33	40.5 [16.5 - 68.3]	35.9 [6.9 - 65]	100.0	100.0	6	33	40.5 [16.5 - 68.3]	35.9 [36.3 - 14.8]	0			
2015-16	ANNUAL	Arkansas	36	35	0	1	1,039	50.5 [45.8 - 55.2]	26.9 [17.5 - 36.3]	91.7	20.4	33	212	28.6 [21.8 - 36.1]	25.7 [29.1 - 5.1]	3	(D)	(D)	(D)
2015-16	ANNUAL	California	182	106	13	63	295,794	39.7 [36.8 - 42.6]	45.4 [41 - 49.9]	63.2	6.2	115	18,484	33.4 [30.4 - 36.6]	49.5 [33.7 - 3.1]	67	277,310	40 [35.2 - 45]	38.5 [22.3 - 2.7]
2015-16	ANNUAL	Colorado	130	127	2	1	2,748	27.8 [25 - 30.7]	45.1 [38.9 - 51.2]	96.9	19.2	126	527	41.6 [36.7 - 46.7]	45.9 [36 - 3.2]	4	(D)	(D)	(D)
2015-16	ANNUAL	Connecticut	66	64	2	0	562	44.4 [38.7 - 50.2]	48.9 [40.5 - 57.3]	93.9	96.3	62	541	44.6 [38.9 - 50.4]	48.9 [34.4 - 4.4]	4	(D)	(D)	(D)
2015-16	ANNUAL	District of Columbia	6	5	1	0	84	28.3 [19.4 - 38.6]	42 [14 - 69.9]	66.7	11.9	4	(D)	(D)	(D)	2	(D)	(D)	(D)
2015-16	ANNUAL	Delaware	21	19	0	2	10,268	60.2 [58.9 - 61.5]	43.2 [28.7 - 57.7]	76.2	0.6	16	57	42.4 [30.4 - 55]	43.1 [36.9 - 9.2]	5	10,211	60.3 [57.9 - 62.6]	43.6 [25.2 - 11.3]
2015-16	ANNUAL	Florida	58	48	4	6	25,532	56.9 [54.4 - 59.4]	38.2 [30.4 - 46]	89.7	18.5	52	4,732	59.6 [57 - 62.2]	37.6 [31.4 - 4.3]	6	20,800	56.4 [47.8 - 64.8]	43.4 [21.9 - 8.9]
2015-16	ANNUAL	Georgia	65	61	3	1	1,460	41.4 [37.5 - 45.3]	35.5 [29 - 42]	92.3	30.5	60	446	41 [34.4 - 47.9]	35.8 [27.5 - 3.5]	5	1,014	41.5 [31.5 - 52]	32.3 [18.4 - 8.2]

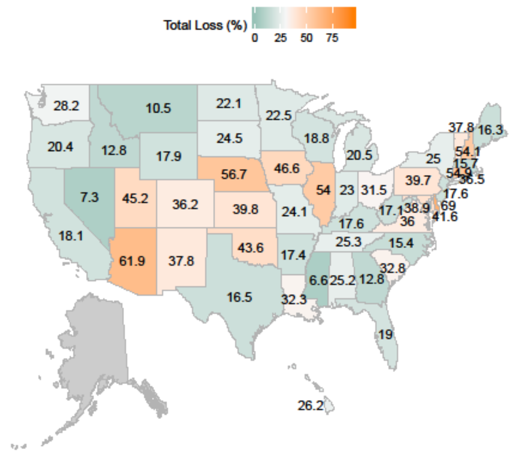
			All operations in the State									Exclusive to the State				Multi-State operations			
SurveyYear	Season	State	N	N backyard	N sideline	N commercial	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	Pt Bk Exclusive To State	Pt Col Exclusive To State	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]	N	Total Col Start	Total Loss [95%CI]	Average Loss [95% CI]
2015-16	ANNUAL	Hawaii	45	42	2	1	2,506	38.2 [34.2 - 42.2]	18.8 [11.8 - 25.9]	97.8	99.8	44	2,500	38.2 [34.3 - 42.3]	19.3 [24.3 - 3.7]	1	(D)	(D)	(D)
2015-16	ANNUAL	Idaho	45	28	1	16	89,127	38.2 [33.1 - 43.4]	51.1 [42.2 - 59.9]	62.2	1.2	28	1,069	27.4 [19.6 - 36.2]	59.5 [33.2 - 6.3]	17	88,058	38.3 [30.1 - 47]	37.2 [18.8 - 4.6]
2015-16	ANNUAL	Illinois	127	125	2	0	730	46.2 [40.7 - 51.8]	50.6 [44.7 - 56.6]	96.9	97.4	123	711	46.5 [40.9 - 52.3]	51.5 [34.3 - 3.1]	4	(D)	(D)	(D)
2015-16	ANNUAL	Indiana	152	148	4	0	1,003	39.5 [34.7 - 44.4]	42.7 [36.9 - 48.6]	98.7	98.5	150	988	39.4 [34.6 - 44.4]	42.9 [36.8 - 3]	2	(D)	(D)	(D)
2015-16	ANNUAL	Iowa	48	45	3	0	541	58.8 [52 - 65.4]	50.1 [41.6 - 58.5]	95.8	64.0	46	346	61.5 [53.6 - 69]	49.3 [30.1 - 4.4]	2	(D)	(D)	(D)
2015-16	ANNUAL	Kansas	32	29	2	1	3,209	56.7 [53 - 60.3]	32.6 [22.2 - 43]	96.9	12.7	31	409	75 [63.4 - 84.6]	31.9 [30.3 - 5.4]	1	(D)	(D)	(D)
2015-16	ANNUAL	Kentucky	71	68	3	0	346	34.5 [28.9 - 40.4]	38.2 [31.2 - 45.3]	98.6	99.7	70	345	34.8 [29.1 - 40.7]	38.6 [30.3 - 3.6]	1	(D)	(D)	(D)
2015-16	ANNUAL	Louisiana	21	19	2	0	578	14.7 [9.2 - 21.7]	19.9 [8.3 - 31.5]	100.0	100.0	21	578	14.7 [9.2 - 21.7]	19.9 [27.1 - 5.9]	0			
2015-16	ANNUAL	Maine	81	77	2	2	29,880	36.6 [32 - 41.5]	42.3 [34.3 - 50.2]	96.3	1.3	78	374	34.4 [28.4 - 40.7]	42.3 [36.9 - 4.2]	3	(D)	(D)	(D)
2015-16	ANNUAL	Maryland	128	119	5	4	13,614	56.1 [53.7 - 58.6]	47 [41.1 - 53]	93.0	9.7	119	1,315	57 [52.3 - 61.7]	48.2 [34.9 - 3.2]	9	12,299	56.1 [47.1 - 64.7]	31.8 [22.6 - 7.5]
2015-16	ANNUAL	Massachusetts	113	112	0	1	1,014	55.8 [50.9 - 60.5]	49.4 [42.7 - 56.1]	95.6	96.7	108	981	56.6 [51.7 - 61.4]	50.2 [36.3 - 3.5]	5	33	32.6 [11.8 - 59.7]	31.8 [29.1 - 13]
2015-16	ANNUAL	Michigan	195	185	8	2	3,533	46 [43.4 - 48.7]	58.4 [53.5 - 63.4]	98.5	30.8	192	1,088	52.3 [47.8 - 56.7]	58.7 [35.5 - 2.6]	3	(D)	(D)	(D)
2015-16	ANNUAL	Minnesota	109	94	8	7	27,310	49.3 [46.3 - 52.2]	60.9 [54.1 - 67.7]	89.0	6.0	97	1,640	68.2 [63.5 - 72.7]	64.3 [36.3 - 3.7]	12	25,670	47.8 [39.6 - 56]	32.9 [19.9 - 5.7]
2015-16	ANNUAL	Mississippi	12	10	0	2	12,148	71.3 [62.2 - 79.4]	36.9 [20.8 - 53.1]	66.7	0.4	8	43	24 [9.1 - 45.1]	29.8 [23.5 - 8.3]	4	(D)	(D)	(D)
2015-16	ANNUAL	Missouri	120	120	0	0	641	33.2 [28.9 - 37.8]	34.4 [29 - 39.9]	98.3	97.2	118	623	33.8 [29.4 - 38.4]	34.7 [30.7 - 2.8]	2	(D)	(D)	(D)
2015-16	ANNUAL	Montana	17	7	1	9	37,498	18.9 [12.3 - 26.9]	33.7 [17.3 - 50]	35.3	0.2	6	59	32.1 [8.6 - 64.9]	44.3 [48.7 - 19.9]	11	37,439	18.8 [10.8 - 29.1]	27.9 [24.5 - 7.4]
2015-16	ANNUAL	Nebraska	16	12	1	3	25,727	40 [31.8 - 48.6]	40.8 [24.3 - 57.4]	81.3	0.5	13	127	28.7 [17.6 - 41.8]	40.9 [36.8 - 10.2]	3	(D)	(D)	(D)
2015-16	ANNUAL	Nevada	5	4	0	1	2,415	40.1 [37.9 - 42.3]	42.3 [16.8 - 67.7]	80.0	0.6	4	(D)	(D)	(D)	1	(D)	(D)	(D)
2015-16	ANNUAL	New Hampshire	48	48	0	0	156	36.1 [28.8 - 43.8]	40.2 [30.5 - 49.9]	89.6	85.9	43	134	33.2 [25.4 - 41.7]	38.7 [35.6 - 5.4]	5	22	51 [35 - 66.9]	53 [17.5 - 7.8]
2015-16	ANNUAL	New Jersey	112	106	4	2	7,191	53.6 [50.4 - 56.7]	34.1 [28.6 - 39.7]	90.2	11.2	101	806	31 [26.5 - 35.8]	33.6 [30.5 - 3]	11	6,385	57.4 [50 - 64.6]	38.9 [26.9 - 8.1]
2015-16	ANNUAL	New Mexico	17	17	0	0	77	54.1 [40.7 - 67.1]	46.9 [32.1 - 61.8]	88.2	92.2	15	71	56.3 [42.9 - 69.2]	53.2 [27.6 - 7.1]	2	(D)	(D)	(D)
2015-16	ANNUAL	New York	145	135	3	7	19,766	46.7 [43.6 - 49.9]	38.9 [33.3 - 44.4]	92.4	6.9	134	1,368	27.2 [23.6 - 31]	38.9 [34.5 - 3]	11	18,398	48 [36.8 - 59.3]	38.4 [30.4 - 9.2]
2015-16	ANNUAL	North Carolina	246	241	3	2	6,985	38 [36.3 - 39.7]	38.9 [34.9 - 42.9]	97.2	22.1	239	1,545	35.4 [32.1 - 38.8]	39.1 [32 - 2.1]	7	5,440	38.8 [35.3 - 42.3]	31.3 [25 - 9.5]
2015-16	ANNUAL	North Dakota	26	4	0	22	161,427	42.5 [35.4 - 49.7]	49.7 [40.5 - 58.8]	11.5	0.0	3	(D)	(D)	(D)	23	161,419	42.5 [34.9 - 50.2]	49.6 [21.2 - 4.4]
2015-16	ANNUAL	Ohio	236	231	5	0	1,446	43.2 [39.6 - 46.8]	41.8 [37.5 - 46.1]	97.5	96.2	230	1,391	43.9 [40.3 - 47.6]	42.2 [33.9 - 2.2]	6	55	27.7 [14.3 - 44.5]	28.7 [20.8 - 8.5]
2015-16	ANNUAL	Oklahoma	38	35	2	1	2,429	57.8 [54.1 - 61.4]	44.5 [35.4 - 53.6]	97.4	24.4	37	593	66.4 [54.9 - 76.8]	44.2 [28.9 - 4.8]	1	(D)	(D)	(D)
2015-16	ANNUAL	Oregon	132	122	1	9	28,350	38.6 [34.8 - 42.5]	41.2 [35.5 - 46.9]	90.9	22.1	120	6,262	60.3 [58.7 - 61.9]	42.5 [34.3 - 3.1]	12	22,088	30.5 [19.6 - 43.2]	28.3 [19.9 - 5.7]
2015-16	ANNUAL	Pennsylvania	599	592	6	1	12,696	57.3 [56.2 - 58.4]	47.9 [45 - 50.7]	98.3	19.2	589	2,436	46.4 [43.9 - 48.9]	48 [35.6 - 1.5]	10	10,260	59.3 [55.5 - 63]	36.8 [22.6 - 7.2]
2015-16	ANNUAL	Puerto Rico	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2015-16	ANNUAL	Rhode Island	19	19	0	0	55	24.5 [12.8 - 39.5]	29.7 [12.6 - 46.8]	84.2	76.4	16	42	27.1 [13.1 - 45.2]	33.5 [40 - 10]	3	(D)	(D)	(D)
2015-16	ANNUAL	South Carolina	97	93	3	1	1,788	33.6 [30.7 - 36.7]	38.1 [32.3 - 43.9]	96.9	29.8	94	533	39.1 [34.4 - 43.9]	38.1 [29.5 - 3]	3	(D)	(D)	(D)
2015-16	ANNUAL	South Dakota	13	6	0	7	57,022	44.2 [35.9 - 52.8]	52.6 [35.3 - 69.9]	38.5	0.0	5	27	29.4 [9.8 - 56.5]	61.3 [40 - 17.9]	8	56,995	44.2 [33.4 - 55.4]	47.2 [27.2 - 9.6]
2015-16	ANNUAL	Tennessee	98	94	4	0	736	27.4 [22.6 - 32.7]	31.3 [25.3 - 37.3]	96.9	92.0	95	677	26.2 [21.3 - 31.5]	31.4 [30.5 - 3.1]	3	(D)	(D)	(D)
2015-16	ANNUAL	Texas	95	74	4	17	104,492	45.8 [42.3 - 49.3]	29.3 [24 - 34.7]	80.0	1.3	76	1,308	49.3 [43.5 - 55.2]	27 [27.2 - 3.1]	19	103,184	45.8 [37.9 - 53.8]	38.5 [22.6 - 5.2]
2015-16	ANNUAL	Utah	38	32	3	3	8,708	59.4 [54.6 - 64]	59.9 [49.8 - 70.1]	86.8	2.8	33	241	52.9 [43.4 - 62.3]	61.1 [32.8 - 5.7]	5	8,467	59.6 [45.6 - 72.6]	51.8 [26.5 - 11.8]
2015-16	ANNUAL	Vermont	48	44	2	2	1,377	15.5 [11 - 20.8]	36.1 [27.7 - 44.6]	87.5	48.7	42	670	25.6 [21.4 - 30]	35.9 [29.7 - 4.6]	6	707	5.4 [0.1 - 25.7]	37.7 [33.8 - 13.8]
2015-16	ANNUAL	Virginia	553	546	7	0	2,565	41.4 [39 - 43.8]	44.9 [42 - 47.9]	97.8	87.2	541	2,236	43 [40.5 - 45.5]	45.2 [35.6 - 1.5]	12	329	26.7 [17.1 - 37.9]	32.9 [25.6 - 7.4]
2015-16	ANNUAL	Washington	118	109	4	5	27,750	31.7 [29.2 - 34.2]	55.9 [49.9 - 61.8]	93.2	2.8	110	774	58.2 [53 - 63.2]	57.3 [32.8 - 3.1]	8	26,976	30.7 [22.2 - 40.1]	36.1 [26.9 - 9.5]
2015-16	ANNUAL	West Virginia	55	51	3	1	776	49.8 [43.1 - 56.4]	41.3 [33.9 - 48.6]	90.9	46.3	50	359	41.5 [35.8 - 47.4]	41.7 [28.1 - 4]	5	417	55.6 [30.7 - 78.7]	36.3 [25.6 - 11.4]
2015-16	ANNUAL	Wisconsin	121	113	5	3	19,073	50.7 [48.2 - 53.3]	54.8 [49 - 60.7]	95.0	19.2	115	3,654	33.8 [29.9 - 37.7]	56.3 [32.9 - 3.1]	6	15,419	52.9 [43 - 62.6]	27.3 [20.7 - 8.5]
2015-16	ANNUAL	Wyoming	26	18	2	6	17,210	38.3 [28.4 - 48.9]	42 [31 - 53]	69.2	1.9	18	325	37.6 [29 - 46.8]	45.6 [31.8 - 7.5]	8	16,885	38.3 [20.6 - 58.4]	33.8 [19 - 6.7]
2015-16	ANNUAL	Other	0																
2015-16	ANNUAL	MultiStateOperation	143	63	12	68	309,643	39.8 [36.5 - 43.1]	35.8 [31.8 - 39.7]	0.0	0.0	143	309,643	39.8 [36.5 - 43.1]	35.8 [24.1 - 2]	143	309,643	39.8 [36.5 - 43.1]	35.8 [24.1 - 2]
2016-17	ANNUAL	Alabama	38	37	1	0	367	34.9 [26.1 - 44.5]	42.7 [32.4 - 53]	97.4	97.5	37	358	34.8 [25.8 - 44.6]	42.7 [32.7 - 5.4]	1	(D)	(D)	(D)
2016-17	ANNUAL	Alaska	0																
2016-17	ANNUAL	Arizona	10	9	1	0	176	65 [50.4 - 77.9]	34.1 [15.7 - 52.4]	80.0	24.4	8	43	22.2 [7.2 - 45.1]	32.2 [28.7 - 10.1]	2	(D)	(D)	(D)
2016-17	ANNUAL	Arkansas	32	29	1	2	1,940	39.7 [36.3 - 43.2]	34.4 [25.2 - 43.6]	90.6	15.3	29	296	35.3 [28.5 - 42.4]	34.4 [27.9 - 5.2]	3	(D)	(D)	(D)
2016-17	ANNUAL	California	163	94	21	48	246,959	30.5 [27.6 - 33.5]	35.7 [31.2 - 40.2]	63.2	20.1	103	49,520	28.8 [26.2 - 31.5]	34 [32.2 - 3.2]	60	197,439	30.8 [25.9 - 36.1]	38.6 [22.8 - 2.9]
2016-17	ANNUAL	Colorado	90	89	1	0	448	48.3 [42.4 - 54.2]	51.8 [44.3 - 59.3]	95.6	95.1	86	426	48.3 [42.1 - 54.5]	52.4 [36.6 - 4]	4	(D)	(D)	(D)
2016-17	ANNUAL	Connecticut	34	33	1	0	345	61.8 [52.1 - 71]	53.9 [41.9 - 65.8]	100.0	100.0	34	345	61.8 [52.1 - 71]	53.9 [35.5 - 6.1]	0			
2016-17	ANNUAL	District of Columbia	20	20	0	0	68	38.7 [27.4 - 50.9]	54.9 [39 - 70.7]	90.0	80.9	18	55	39.6 [27.5 - 52.5]	55.8 [36.8 - 8.7]	2	(D)	(D)	(D)
2016-17	ANNUAL	Delaware	38	37	1	0	336	74 [64.6 - 82.2]	60 [50.1 - 69.9]	86.8	84.2	33	283	79.8 [70.7 - 87.3]	60.5 [31.5 - 5.5]	5	53	48.2 [23.5 - 73.6]	56.4 [31.5 - 14.1]
2016-17	ANNUAL	Florida	62	46	9	7	46,181	29.2 [24.1 - 34.6]	43 [35.5 - 50.6]	82.3	4.2	51	1,950	43.6 [37.2 - 50.2]	42.1 [31.8 - 4.5]	11	44,231	28.7 [17.1 - 42.6]	47.4 [21.5 - 6.5]
2016-17	ANNUAL	Georgia	81	67	7	7	25,731	30.5 [27.1 - 34.1]	47.7 [42.1 - 53.3]	87.7	8.2	71	2,111	45.7 [40.5 - 51.1]	49.9 [25.9 - 3.1]	10	23,620	29.1 [20.3 - 39.1]	31.5 [18.5 - 5.9]
2016-17	ANNUAL	Hawaii	10	10	0	0	75	26.2 [11.5 - 45.7]	26.4 [4.4 - 48.3]	100.0	100.0	10	75	26.2 [11.5 - 45.7]	26.4 [35.4 - 11.2]	0			
2016-17	ANNUAL	Idaho	30	23	1	6	51,283	27.3 [20.7 - 34.6]	54.3 [40.5 - 68.2]	83.3	1.9	25	951	29.2 [22.9 - 36]	58.5 [40.5 - 8.1]	5	50,332	27.2 [11.7 - 47.9]	33.5 [18.6 - 8.3]
2016-17	ANNUAL	Illinois	94	93	1	0	467	59.1 [52.9 - 65]	60.5 [53.7 - 67.4]	97.9	99.6	92	465	58.9 [52.6 - 64.9]	60.9 [33.7 - 3.5]	2	(D)	(D)	(D)
2016-17	ANNUAL	Indiana	99	96	3	0	529	41.4 [36 - 46.9]	40.9 [34.9 - 46.8]	100.0	100.0	99	529	41.4 [36 - 46.9]	40.9 [30.1 - 3]	0			
2016-17	ANNUAL	Iowa	71	70	1	0	400	68.6 [61.5 - 75.2]	47.6 [39.3 - 55.8]	98.6	99.0	70	396	70.4 [63.5 - 76.8]	48 [35.7 - 4.3]	1	(D)	(D)	(D)
2016-17	ANNUAL	Kansas	16	15	0	1	14,129	47.7 [46.4 - 49]	36.7 [22.7 - 50.6]	93.8	0.9	15	129	30.9 [20.1 - 43.3]	35.9 [29.3 - 7.6]	1	(D)	(D)	(D)
2016-17	ANNUAL	Kentucky	50	47	1	2	2,038	40.5 [34.7 - 46.5]	38.2 [29.2 - 47.1]	94.0	27.8	47	567	57.7 [48.7 - 66.4]	39 [33 - 4.8]	3	(D)	(D)	(D)
2016-17	ANNUAL	Louisiana	18	14	2	2	3,053	36.1 [31.2 - 41.1]	35.6 [22.3 - 49]	88.9	11.2	16	341	42.4 [28.8 - 56.9]	36.1 [30.8 - 7.7]	2	(D)	(D)	(D)
2016-17	ANNUAL	Maine	65	59	3	3	23,635	23.3 [19.7 - 27.1]	57.2 [49.1 - 65.3]	93.8	1.4	61	340	48 [41.3 - 54.7]	57.6 [33.2 - 4.3]	4	(D)	(D)	(D)
2016-17	ANNUAL	Maryland	127	121	3	3	4,476	55 [52.3 - 57.6]	48.6 [42.9 - 54.3]	90.6	32.6	115	1,457	58.3 [53.7 - 62.8]	48.4 [34.1 - 3.2]	12	3,019	53.1 [51.5 - 54.7]	51.1 [15.1 - 4.4]
2016-17	ANNUAL	Massachusetts	87	86	0	1	13,626	15.9 [14.5 - 17.3]	52.6 [45.3 - 60]	94.3	2.3	82	315	48.4 [41.3 - 55.5]	52.7 [35.1 - 3.9]	5	13,311	15.3 [13.4 - 17.2]	52 [36.1 - 16.1]
2016-17	ANNUAL	Michigan	138	127	8	3	9,023	32.6 [30.5 - 34.8]	61.2 [55.6 - 66.8]	96.4	12.3	133	1,113	47.9 [43 - 52.8]	62.2 [33.9 - 2.9]	5	7,910	30.3 [26.1 - 34.7]	34.5 [9.8 - 4.4]
2016-17	ANNUAL	Minnesota	79	68	4	7	15,623	49.4 [42.7 - 56.1]	56.6 [48.5 - 64.7]	87.3	6.9	69	1,072	39 [34.3 - 43.8]	57.8 [37.4 - 4.5]	10	14,551	50.3 [30.9 - 69.8]	47.9 [32 - 10.1]
2016-17	ANNUAL	Mississippi	9	4	1	4	14,547	26.3 [23.2 - 29.5]	43.3 [29.9 - 56.8]	22.2	0.2	2	(D)	(D)	(D)	7	14,522	26.2 [22.9 - 29.8]	38.7 [17 - 6.4]
2016-17	ANNUAL	Missouri	88	85	3	0	755	33.6 [29.2 - 38.3]	36.1 [30.1 - 42.2]	96.6	93.6	85	707	33.4 [28.7 - 38.4]	35.8 [29.4 - 3.2]	3	(D)	(D)	(D)
2016-17	ANNUAL	Montana	21	13	2	6	26,403	17.1 [13.5 - 21.1]	44.2 [30.6 - 57.9]	52.4	0.2	11	65	40.2 [24.6 - 57.2]	50.1 [29.4 - 8.9]	10	26,338	17 [12 - 23]	37.8 [34.8 - 11]
2016-17	ANNUAL	Nebraska	15	15	0	0	180	72.1 [58.7 - 83.3]	67.1 [55.2 - 79.1]	93.3	83.3	14	150	65.5 [52.4 - 77.1]	65.1 [23.2 - 6.2]	1	(D)	(D)	(D)
2016-17	ANNUAL	Nevada	13	12	0	1	1,476	23 [17.1 - 29.6]	63.1 [45.8 - 80.5]	92.3	5.1	12	76	68.8 [53.6 - 81.6]	66.6 [30.6 - 8.8]	1	(D)	(D)	(D)
2016-17	ANNUAL	New Hampshire	49	48	1	0	385	60.4 [54.4 - 66.1]	65.7 [56 - 75.5]	93.9	49.9	46	192	69 [60.3 - 76.9]	64.5 [35.3 - 5.2]	3	(D)	(D)	(D)
2016-17	ANNUAL	New Jersey	74	71	2	1	2,969	41.4 [38.2 - 44.8]	44.5 [37.2 - 51.8]	93.2	15.2	69	450	50.2 [43.6 - 56.8]	44 [31.6 - 3.8]	5	2,519	39.3 [32.7 - 46.3]	51.7 [41.6 - 18.6]
2016-17	ANNUAL	New Mexico	19	17	2	0	285	35.4 [26.2 - 45.3]	61 [46.3 - 75.6]	94.7	29.8	18	85	38.8 [23.9 - 55.3]	62.5 [32.8 - 7.7]	1	(D)	(D)	(D)
2016-17	ANNUAL	New York	143	127	8	8	17,937	43.8 [41 - 46.6]	53.9 [48.3 - 59.6]	92.3	14.1	132	2,527	59.7 [56 - 63.4]	54.6 [34.9 - 3]	11	15,410	41.2 [32.4 - 50.4]	45.6 [26.6 - 8]
2016-17	ANNUAL	North Carolina	206	200	4	2	5,784	29.9 [27.1 - 32.8]	42 [37.5 - 46.5]	95.6	21.3	197	1,230	40.2 [36.4 - 44]	42.4 [33.2 - 2.4]	9	4,554	26.3 [15.9 - 38.9]	34.6 [25.6 - 8.5]
2016-17	ANNUAL	North Dakota	17	3	0	14	104,636	37.8 [27.6 - 48.7]	48.9 [37.8 - 60]	11.8	0.0	2	(D)	(D)	(D)	15	104,630	37.8 [27 - 49.5]	48.3 [24.9 - 6.4]
2016-17	ANNUAL	Ohio	233	229	4	0	1,490	39.1 [35.1 - 43.1]	48.5 [43.9 - 53.1]	97.9	89.5	228	1,334	39.5 [35.5 - 43.7]	48.6 [36 - 2.4]	5	156	32.4 [18.4 - 49]	42.3 [24.7 - 11]
2016-17	ANNUAL	Oklahoma	29	27	0	2	3,506	83.9 [75.7 - 90.3]	26.4 [17.7 - 35.2]	96.6	19.3	28	677	25.3 [21.3 - 29.7]	24.2 [21 - 4]	1	(D)	(D)	(D)
2016-17	ANNUAL	Oregon	137	129	3	5	25,281	32.4 [29.7 - 35.3]	50.9 [45.2 - 56.6]	93.4	2.4	128	603	59.2 [53.9 - 64.3]	51.6 [34.2 - 3]	9	24,678	31.6 [21.8 - 42.6]	40.9 [31.8 - 10.6]
2016-17	ANNUAL	Pennsylvania	581	560	18	3	8,128	51.7 [49.8 - 53.5]	61.9 [59.1 - 64.8]	97.6	40.3	567	3,275	59.1 [56.6 - 61.5]	62.2 [35.2 - 1.5]	14	4,853	47 [38.1 - 56.1]	52.5 [29.3 - 7.8]
2016-17	ANNUAL	Puerto Rico	0																
2016-17	ANNUAL	Rhode Island	15	15	0	0	49	44.7 [29.9 - 60.2]	54.5 [36.7 - 72.2]	80.0	57.1	12	28	52.2 [33.6 - 70.4]	56 [37.7 - 10.9]	3	(D)	(D)	(D)
2016-17	ANNUAL	South Carolina	53	50	1	2	2,223	53.8 [49.8 - 57.7]	38.9 [30.1 - 47.7]	94.3	14.2	50	316	37.4 [31.1 - 43.9]	39.3 [33 - 4.7]	3	(D)	(D)	(D)
2016-17	ANNUAL	South Dakota	12	7	1	4	19,684	32.2 [26.2 - 38.6]	39.7 [23.2 - 56.3]	50.0	0.4	6	81	15.5 [3.4 - 38]	29.9 [32.3 - 13.2]	6	19,603	32.2 [23.6 - 41.8]	49.6 [24.7 - 10.1]
2016-17	ANNUAL	Tennessee	57	54	3	0	713	49 [41.8 - 56.3]	39.1 [31.6 - 46.6]	100.0	100.0	57	713	49 [41.8 - 56.3]	39.1 [28.8 - 3.8]	0			
2016-17	ANNUAL	Texas	136	122	5	9	42,249	34.9 [32.1 - 37.7]	26.4 [21.8 - 31.1]	92.6	9.0	126	3,806	27.7 [25 - 30.5]	25.3 [27.7 - 2.5]	10	38,443	35.7 [25.4 - 47]	40.7 [26.4 - 8.3]
2016-17	ANNUAL	Utah	167	164	2	1	1,682	53.2 [49.9 - 56.5]	66.5 [60.9 - 72.1]	97.0	36.3	162	610	54.7 [49.6 - 59.8]	66.3 [37.4 - 2.9]	5	1,072	52.5 [40.5 - 64.2]	72.1 [16.9 - 7.6]
2016-17	ANNUAL	Vermont	43	38	4	1	1,169	48.5 [43.5 - 53.5]	60.8 [50.5 - 71.2]	93.0	83.4	40	975	45.6 [40.5 - 50.7]	59.4 [35.1 - 5.5]	3	(D)	(D)	(D)
2016-17	ANNUAL	Virginia	371	365	6	0	1,880	44.1 [41.1 - 47.2]	42.7 [39.2 - 46.1]	97.0	94.8	360	1,783	43 [39.9 - 46.1]	42.5 [34.6 - 1.8]	11	97	56.5 [43.5 - 68.8]	49 [23.2 - 7]
2016-17	ANNUAL	Washington	89	79	4	6	49,487	39.7 [37.1 - 42.4]	52.4 [44.7 - 60]	89.9	1.0	80	510	48.6 [41.9 - 55.4]	53.8 [38.4 - 4.3]	9	48,977	39.6 [31.4 - 48.3]	39.8 [13.8 - 4.6]
2016-17	ANNUAL	West Virginia	52	48	4	0	628	26.6 [21 - 32.8]	31.8 [24.1 - 39.6]	94.2	79.8	49	501	27.7 [21.6 - 34.4]	32.7 [29.1 - 4.2]	3	(D)	(D)	(D)
2016-17	ANNUAL	Wisconsin	99	89	8	2	13,507	29.4 [26.1 - 32.9]	61.4 [54.9 - 67.9]	93.9	10.1	93	1,360	60.3 [55.4 - 65]	62.1 [33.1 - 3.4]	6	12,147	24 [18 - 30.8]	50.6 [33 - 13.5]
2016-17	ANNUAL	Wyoming	18	15	1	2	4,972	23.4 [19.5 - 27.7]	45.6 [31 - 60.3]	77.8	1.4	14	70	46.1 [32.9 - 59.7]	46.2 [33.3 - 8.9]	4	(D)	(D)	(D)
2016-17	ANNUAL	Other	1	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
2016-17	ANNUAL	MultiStateOperation	126	53	21	52	215,518	31.8 [28.3 - 35.4]	44.8 [40.2 - 49.4]	0.0	0.0	126	215,518	31.8 [28.3 - 35.4]	44.8 [26.3 - 2.3]	126	215,518	31.8 [28.3 - 35.4]	44.8 [26.3 - 2.3]

Appendix 3. *Maps of State Estimates*

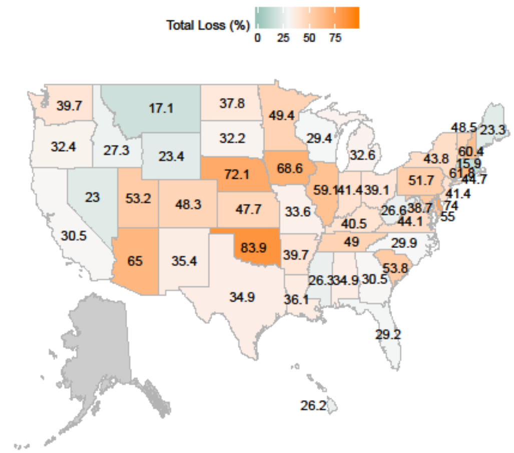
a)Total Loss (%): SUMMER 2016–17 MSO in



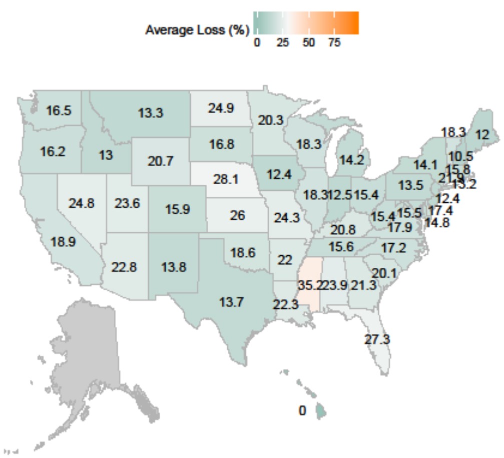
b)Total Loss (%): WINTER 2016–17 MSO in



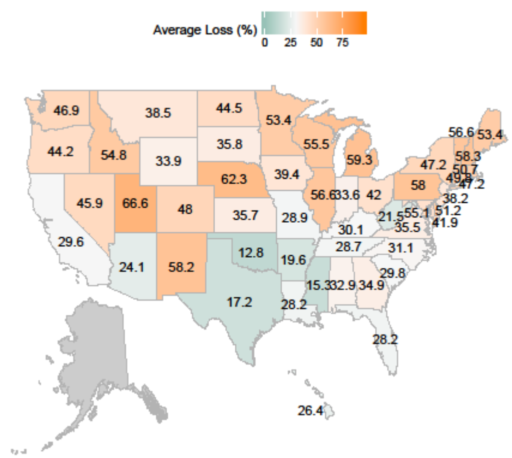
c)Total Loss (%): ANNUAL 2016–17 MSO in



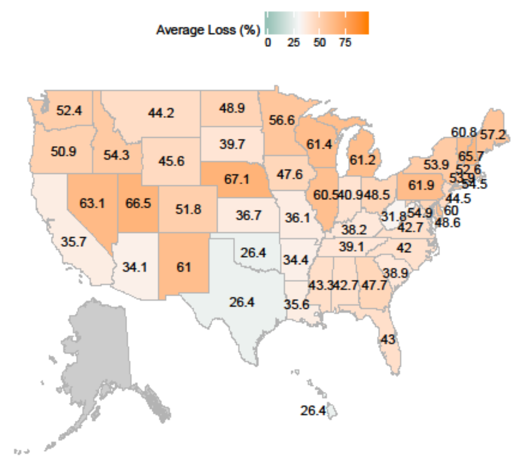
d)Average Loss (%): SUMMER 2016–17 MSO in

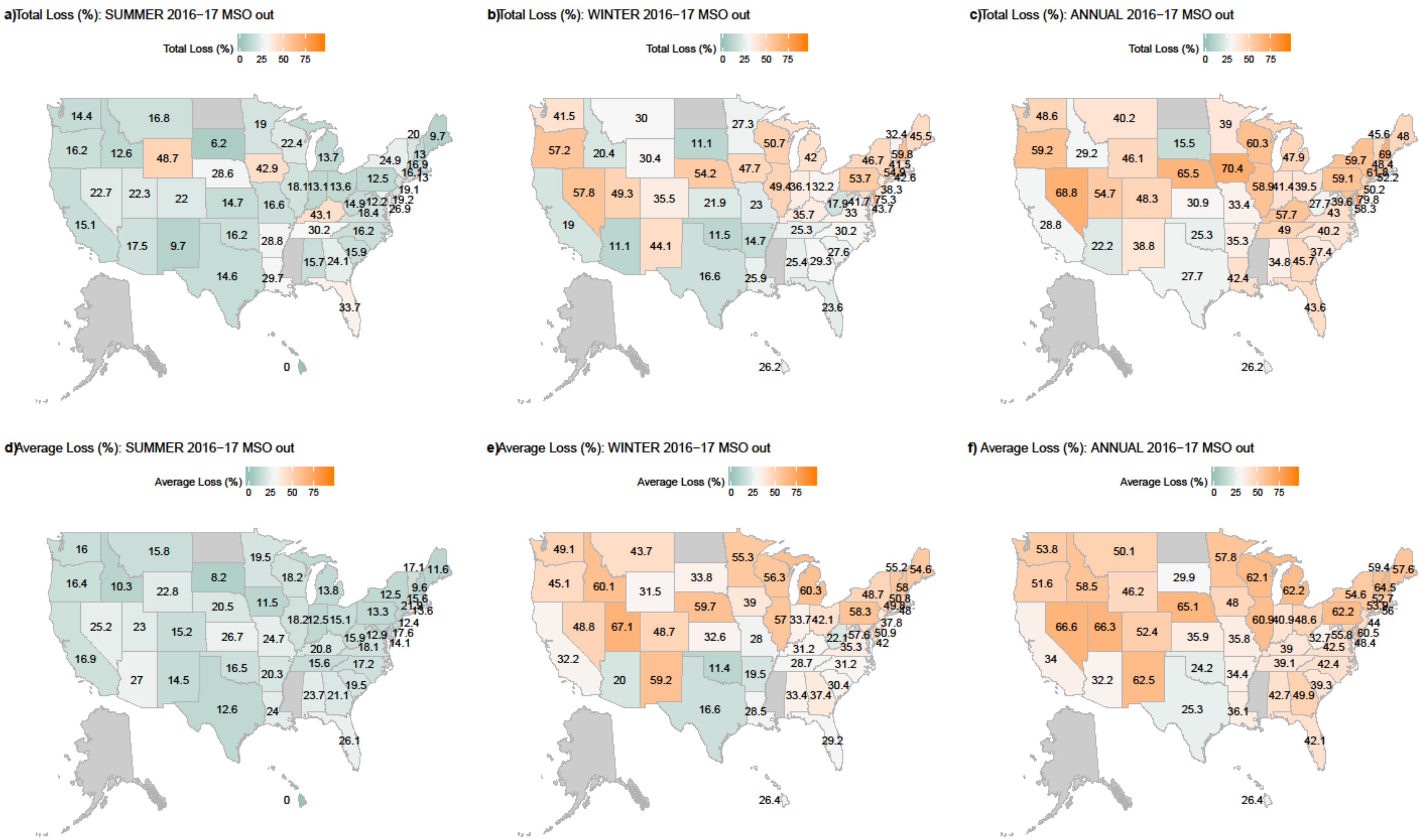


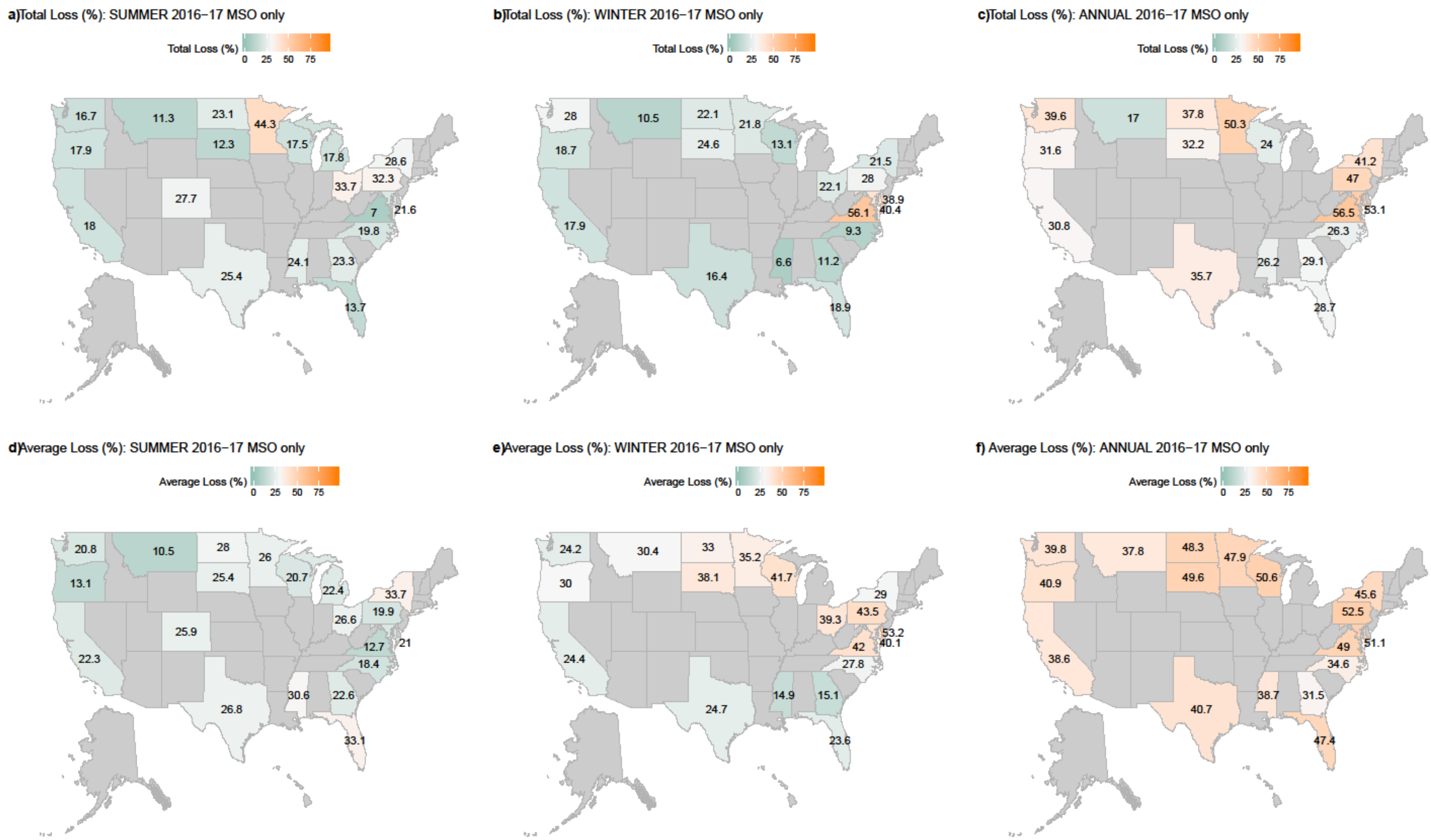
e)Average Loss (%): WINTER 2016–17 MSO in



f) Average Loss (%): ANNUAL 2016–17 MSO in

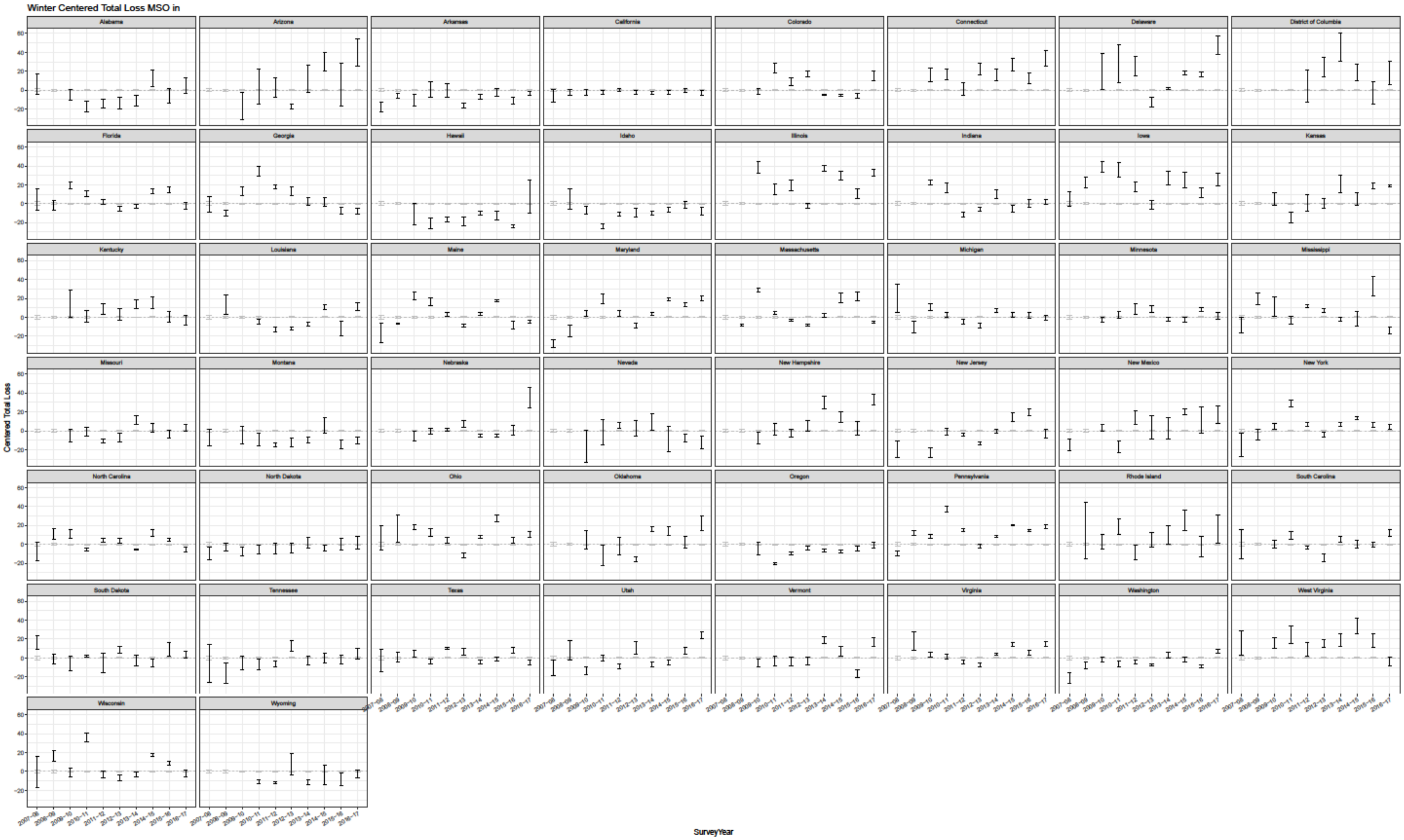


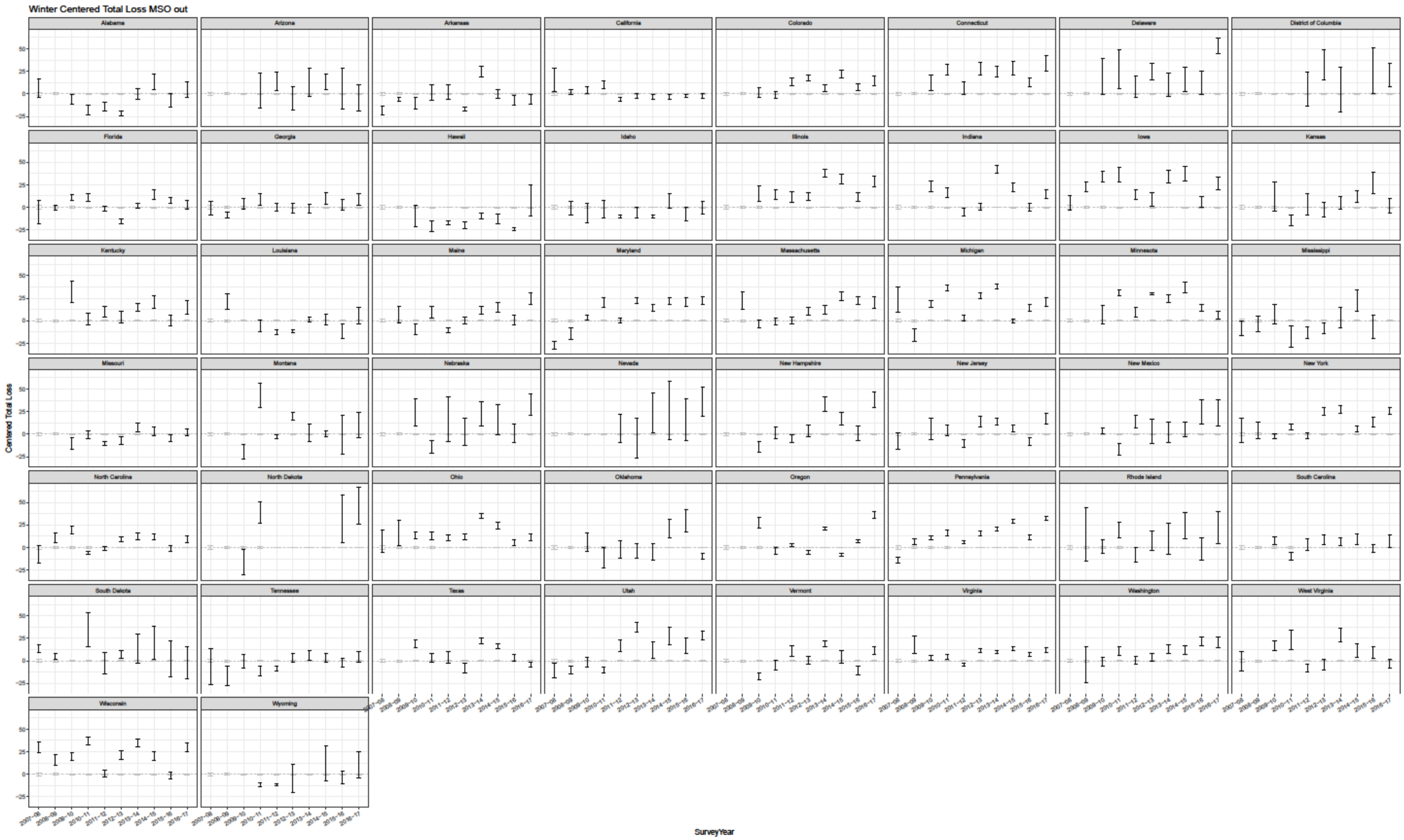

a)Total Loss (%): SUMMER 2016−17 MSO out
Total Loss (%)
0 25 50 75
b)Total Loss (%): WINTER 2016−17 MSO out
Total Loss (%)
0 25 50 75
c)Total Loss (%): ANNUAL 2016−17 MSO out
Total Loss (%)
0 25 50 75
d)Average Loss (%): SUMMER 2016−17 MSO out
Average Loss (%)
0 25 50 75
e)Average Loss (%): WINTER 2016−17 MSO out
Average Loss (%)
0 25 50 75
f) Average Loss (%): ANNUAL 2016−17 MSO out
Average Loss (%)
0 25 50 75

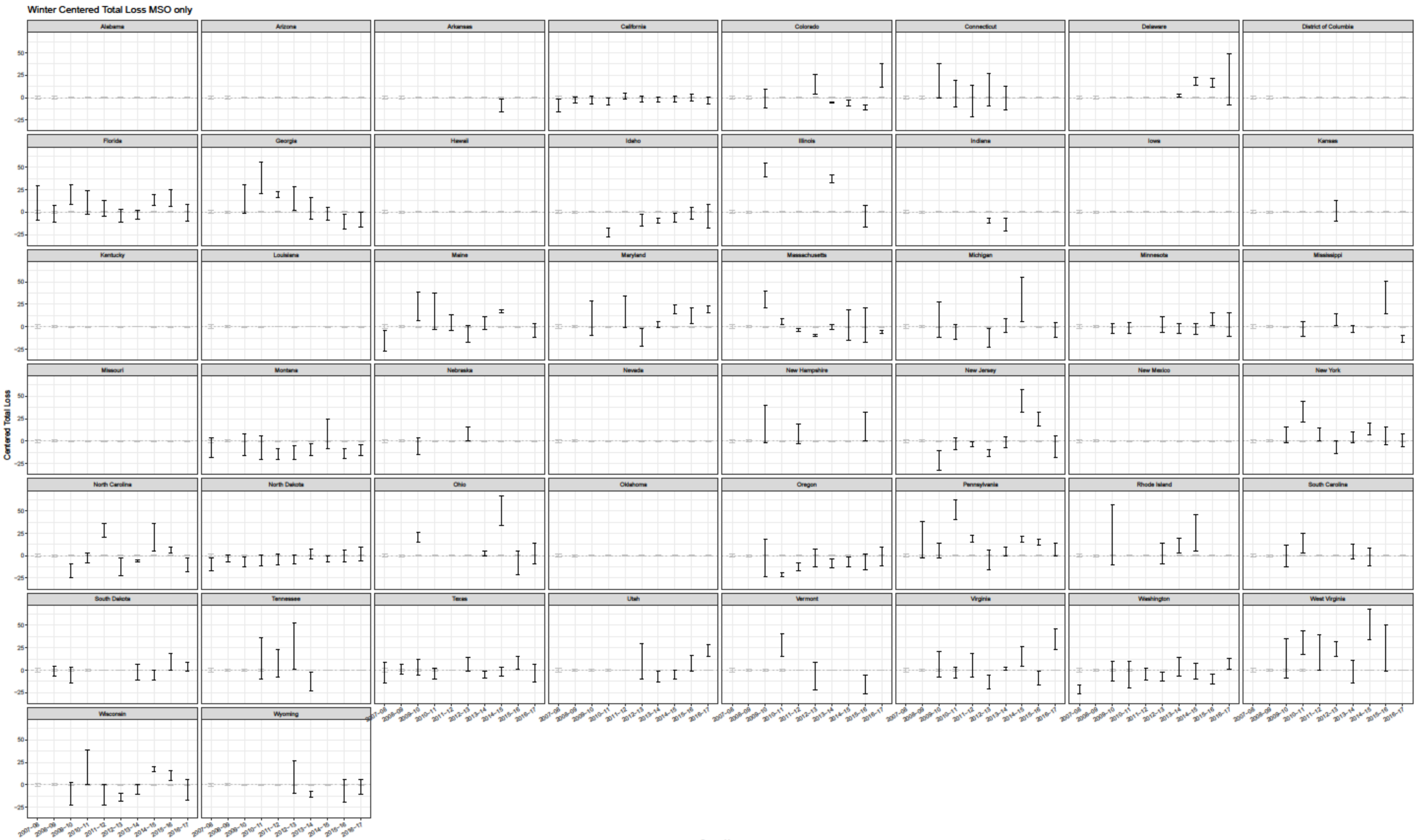


Legend: MSO = Multi-State Operations: MSO in = such operations included; MSO out = such operations excluded; MSO only = Multi-State operations exclusively.

Appendix 4. *Centered States Estimates*




Winter Centered Total Loss MSO out
Centered Total Loss
SurveyYear



Legend: Centered Total Loss = residuals to the national average (for each year); MSO = Multi-State Operations: MSO in = such operations included; MSO out = such operations excluded; MSO only = Multi-State operations exclusively.

Appendix 5. <u>*Contributing experts*</u>

Background and expertise of the contributing experts (as of 2015, when contribution was granted). Legend: Contribution phase 2: Conversion of criteria options into scores (see description in methods, section 1.1.2 in Chapter 5); Contribution phase 3: Weighting of criteria scores (see description in methods, section 1.1.4 in Chapter 5).

Expert Name	Background (title and positions)	Field of expertise	Experience in the field	Keywords	Contribution
Dewey Caron	Emeritus Professor U of DE	Apiculture	47 yrs	extension specialist teacher author, BIP stakeholder committee	Phases 2&3
Wayne Esaias	PhD Biological Oceanography, Retired NASA	Remote Sensing of Nectar Phenology and Climate Effects	20-35 yrs, beekeeper 22 yrs	Environmental Effects, Nectar Flow Phenology, Climate Effects, Hive Scales	Phase 3
Jerry Hayes	Beelogics commercial Lead, Monsanto	Apiculture, Honey bee health	30 yrs (8 yrs Apiary insepctor ; 2 yrs industry)	Apiary Inspector, *Varroa*, disease, commercial beekeeping	Phases 2&3
Eugene Lengerich	Professor of Public Health Sciences, Penn State	Epidemiology	20 yrs	Risk factors, Prevention, Mortality, Morbidity, Community-based	Phase 3
Katie Lee	MS in Entomology, PhD student in Entomology, Midwest Tech-Transfer Team Lead	Sampling commercial beekeeping	9 yrs	Sampling, *Varroa*, Fieldwork, commercial beekeepers, disease	Phases 2&3
Megan Mahoney	BIP Tech-Transfer Team Crop Protection Agent	Beekeeping	8 yrs	Commercial beekeeper, queens	Phase 3
Jeff Pettis	Research leader, USDA, Beltsville Bee Laboratory	Entomology, honey bee health, toxicology, pathology	30 yrs	Pesticides, queens, disease	Phases 2&3
Ben Sallmann	BIP Tech-Transfer Team Crop Protection Agent	Beekeeping	5 yrs	Commercial beekeeping	Phase 3
Rob Snyder	BIP Tech-Transfer Team Crop Protection Agent	Beekeeping	9 yrs	Commercial beekeeping, queen rearing	Phase 3
Marla Spivak	Professor and Extension Entomologist, Department of Entomology, Univ Minnesota	Honey bee health, behavior, pathology	30 yrs	social immunity, breeding, behavior, management	Phase 3

Liana Tiegen	BIP Tech-Transfer Team Crop Protection Agent	Beekeeping	5 yrs	Tech-Transfer Team, Commercial Beekeeping, UF's HBREL, honey production, pollination	Phases 2&3
Ellen Topitshofer	BIP Tech-Transfer Team member, PNW region	Entomology, Apiculture	3 yrs	Scientist-in-training, field technician, educator, lab technician, public speaker	Phases 2&3
James Wilkes	PhD in Computer Science, Beekeeper for 15 years, Sideliner with about 100 colonies for past 4 years.	Computer Science Education, Beekeeping	30 yrs in computer science, 15 in beekeeping	computing, programming, teaching, software, grants, sideline, honey, sourwood, marketing, farming	Phases 2&3
Dan Wyns	BIP-PNW Tech Transfer Team	Commercial Beekeeping, Pollination, Honey Production, Queen Rearing	BIP: <1 yr, Commercial: 8 yrs, Inspector: 3 yrs	Commercial beekeeper, BIP, apiary inspector, pollination, queens	Phases 2&3

Appendix 6. ***Best Management Practices Scoring Guide***

ID	Criteria	Score: 0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	**2** *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
	DOMAIN 1: BEEKEEPER					
1.1	**Years of Beekeeping**					
	For OT = small-scale (<50 colonies)	First year beekeeper	Second year beekeeper	Less than 5 years' experience	Between 5 and 15	Over 15 years' experience
	For OT = professional (>50 colonies)	Less than 5 years' experience	Between 5 and 20 years' experience	Between 20 and 30 years' experience	Between 30 and 40 years' experience	Over 40 years' experience
	"Approximately how many years have you been keeping bees? " (numeric answer)					
	The more experienced the beekeeper, the less susceptible to management mistakes. Thresholds are based on quartiles of distribution per operation type.					
1.2	**Sources of Information (count)**	None selected	1-2 selected	3-5 selected	6-8 selected	Over 8
	"What are your primary sources of bee health information?"(multiple choice)					
	Options: Other beekeepers (Mentor, Friends, Family, Neighbors...) ; Beekeeping Class ; Beekeeping Club/Association meetings ; Online (blogs, videos, media, ...) ; Books ; Bee Journals or Magazines ; Scientific publications ; Beekeeping Association Newsletters; Beekeeping Conventions ; Suppliers (of beekeeping equipment) ; Apiary inspector (or any state officials) ; University Extension / Outreach ; Bee Informed Partnership.					
	The more diverse the sources of information, the more informed and up-to-date the beekeeper. Assumption: all options are equivalent in terms of quality.					
1.3	**Beekeeping Education**	None selected	Only self-taught (books, internet,...)	From a mentor beekeeper OR through a Beekeeping class	From a mentor beekeeper AND through a Beekeeping class	Mentor AND class AND self-taught
	"How did you first learn beekeeping? "(multiple choice)					
	Options: From a mentor beekeeper (friend or family) ; From a Beekeeping Class (bee group, bee club, organization, master beekeeper class, ...); On my own (books, internet, ...).					
	Assumption: a more complete education is to be favored.					
	DOMAIN 2: EQUIPMENT					
2.1	**Equipment Type**	Top bar hives	at least one Homemade	Only Nucs OR Warre		Only Standardized equipment (Langstroth)
	"What hive type do you use to keep your colonies?"(multiple choice)					
	Options: Standard Langstroth 10 frame hives (even if use less than 10 frames in it) ; Standard Langstroth 8 frame hives (even if use less than 8 frames in it) ; Top bar hives ; Warre ; Nucs boxes ; Home-made boxes (NOT Langstroth dimensions).					
	Justification: "top bar" not meant for cold winters; "nuc"s are not intended to carry hive yearlong; "homemade" might be less easy to maintain, clean...					
2.2	**Foundation Type**	Foundation-less		Duragilt OR Plastic foundation		Wax foundation
	"When adding new frames, what type of foundation do you use? " (multiple choices)					
	Options: Foundation-less ; Wax foundation ; Plastic foundation ; Duragilt.					
	Justification: Wax foundation closest to natural state; "no foundation" requires more energy from the bees.					
2.3	**Average Comb Age**	Don't know	Less than 1 year OR Over 5 years	Between 4 and 5 years	Between 2 and 4 years	Between 1 and 2 years
	"On average, how old is the brood comb in your colonies?" (single choice)					
	Options: Less than 1 year old ; Between 1 and 2 years old ; Between 2 and 3 years old ; Between 3 and 4 years old ; Between 4 and 5 years old ; More than 5 years old ; I don't know.					
	Justification: Not knowing shows carelessness, the more replaced (recent) the less accumulation, but need at least 1 year for comb drawing.					
2.4	**October Brood Chamber Size**					
	Northern States	Don't know		1 deep	1 deep and 1 medium	2 deeps OR more
	Southern States	Don't know		2 deeps OR more	1 deep	1 deep and 1 medium
	"On October 1 2013, how large on average were the brood chambers in your colonies?" (single choice)					
	Options: Equivalent to 2 mediums (or 1 deep) ; Equivalent to 3 mediums (or 1 deep and 1 medium) ; Equivalent to 4 mediums (or 2 deeps) ; More than 4 mediums (or 2 deeps) ; Does not apply to my hive type ; I did not keep bees on that date ; I don't know.					
	Justification: the larger brood chamber, the less risky to prepare overwintering. Those for which this question does not apply (NoBees) should have their score unchanged.					
2.5	**Comb Culling and Storage Technique**	With napthalene	Use moth crystals OR fumigated	No particular treatment	Culled and replaced bad combs	Did not reuse old comb OR Froze the comb
	"Last year (April 1, 2013 - April 1, 2014), what did you do before you re-used brood comb that you had taken out of production or purchased?" (multiple choice)					
	Options: I did not reuse any old brood comb ; I did not treat the comb in any particular way ; I culled any particularly old or bad combs and replaced them ; I irradiated the comb ; I fumigated the comb with acetic acid ; I froze the comb ; I stored the comb with paradichlorobenzene crystals (moth crystals) ; I stored the comb with naphthalene (moth balls).					
	Justification: naphthalene is toxic to bees; re-using old brood comb might increase the risk of contagion between colonies; freezing kill N.cerana.					

ID	Criteria	0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	**2** *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
2.6	**Action on Deadouts**					
		Stored the dead equipment		A mix of both		Immediately replaced the dead colony
	"Generally, when you found a dead and/or weak colony in your operation over the last year you would … " (single choice) Options: I immediately replaced the dead colony by splitting frames of bees/brood from other strong colonies into the dead out equipment ; I packed up the dead equipment and stored it for re-use at a later date ; A mixture of both, I immediately replaced some and packed up others ; I did not find dead colonies. *Those for which this question does not apply (NoDeadCols) should have their score unchanged.*					
2.7	**Winter Preparation Technique**					
	Northern States	None	1 practice	2 practices	3 practices	4 practices or more
	Southern States			None	1 practice	2 practices or more
	"Which of the following (other than feeding), did you use to prepare for last winter (2013-2014)?" (multiple choice) Options: I did not prepare my colonies for winter ; I created or engaged an upper entrance ; I used an entrance reducer ; I wrapped my colonies with insulation ; I wrapped my colonies with tar paper or wintering sleeve ; I placed extra insulation on top of colony ; I equalized colony strength ; I moved my colonies to southern location ; I moved my colonies to inside wintering buildings ; I used mouse guards. *Justification: The scoring of WinterPrep depends on the State of the operation: in the south, "winter prep" is not essential (=0) as it is in the Northern states.* *Assumption: all options are equivalent in terms of quality.*					
	DOMAIN 3: QUEENS AND NEW COLONIES					
3.1	**Queens**					
3.1.1	**Average Queen Age**					
		Don't know	Older than 2 years	Less than 6 months	Between 1 year and 2 years	Between 6 months and 1 year
	"How old on average were the queens that headed a majority (>50%) of your colonies on 1 October 2013?"(single choice) Options: Less than 6 months ; Between 6 months and 1 year ; Between 1 and 2 years ; Older than 2 years ; I don't know. *Justification: The most prolific queens are less than 1 year old.*					
3.1.2	**Queens Replaced (Y/N)**					
		No				Yes
	"Last year (April 1 2013 to April 1 2014), did you replace the queen of any of your colonies? (Say yes also if natural requeening)" (single choice).					
3.1.2.1	**Queens Replaced (PCol)**					
		Don't know	1 to 25 %	26 to 75 %	76 to 99 %	100% of the colonies
	"In what percentage of the colonies in your operation did you replace queens over the last year?" (single choice) Options: I did not replace queens in my colonies (0%) ; Less than a quarter of my colonies (1-25%) ; Between a quarter and half of my colonies (26-50%) ; Between half and 3 quarters of my colonies (51-75%) ; Most of my colonies (75-99%) ; All Colonies (100%) ; I don't know. *(0P = Not replaced this year > consider as QueenReplacedYN = No)*					
3.1.2.2	**ReQueening Technique**					
		Don't know	Let replacement occur naturally	Introduced Virgin Queens OR Introduced Queen Cells	Introduced Mated Queens	Introduced Nucs
	"How did you re-queen the colonies that you re-queened last year?" (multiple choice) Options: I introduced mated queens ; I introduced virgin queens ; I introduced queen cells ; I introduced queen right nucs ; I permitted colony or split to rear a new replacement queen on its own ; I don't know. *Justification: introduced queens indicate a more selective management; already mated is less risky than virgin. Greatest acceptance with nuc introduction.*					
3.1.2.3	**Queen Source**					
		Don't know	another beekeeper	a commercial producer	Self-reared	
	"If you introduced mated or virgin queens and/or queen cells, where did you get the majority (>50%) of these queens?" (multiple choice) Options: From commercial producers ; From another beekeeper (non commercial producer) ; I reared them myself ; I don't know. *Justification: origin= other beekeeper is the most risky in terms of spreading diseases, rearing queens on your own allows to select for desired traits.*					
3.2	**New Colonies**					
3.2.1	**Started New Colonies (Y/N)**					
		No				Yes
	"Did you start or obtain any new colonies between 1 April 2013 and 1 April 2014?"(single choice). *Justification: starting new colonies helps to decrease disease loads: established colonies will develop disease quicker.*					
3.2.1.1	**New Colonies Technique**					
		Packages	Swarms	Nucs	Established hives	From Splits
	"How did you start or obtain new colonies over the last year?" (multiple choice) Options: I made increases by splitting strong colonies ; I bought and installed packages ; I bought and installed nucs ; I bought (or received) hives from another beekeeper ; I caught and installed swarms. *Justification: receiving new bees from outside might bring in diseases. Packages and swarms take a lot of resources.*					
	DOMAIN 4: SEASONAL MANAGEMENT					
4.1	**Movement of colonies**					
4.1.1	**Moved across state lines (Y/N)**					
		Yes				No
	"Did you move any of your colonies last year (between April 1, 2013 and April 1, 2014) at least once across state lines?" (single choice) *Justification: moving livestock is more risky in terms of contagion and risk of accident.*					
4.1.2	**Moved across state lines (PCol)**					
		Don't know	100% of the colonies	76 to 99 %	26 to 75 %	1 to 25 %
	"Approximately what percentage of your operation moved across state lines at least once between April 1, 2013 and April 1, 2014?" (numeric). *Justification: the more of the stock is concerned, the higher the risk*					
4.1.3	**States (count)**					
		Present in over 5 states		Present in 4 to 5 states		Present in 3 states or less
	*"Please indicate in which states you kept bees for the months listed." (selection states*months).* *Justification: Risk increase with the number of states crossed.*					

ID	Criteria	0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	**2** *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
4.2	**Honey Production**					
4.2.1	**Honey Harvest (Y/N)**	No		Never		Yes
	"Last year (April 1 2013 to April 1 2014), did you remove or harvest any honey from your colonies?" (single choice).					
	Options: Yes, I harvested honey last year ; No, I did not harvest honey last year though I usually do ; No, I never attempt to harvest or remove honey.					
4.2.2	**Honey Produced (lbs)**	0-20 lbs		20-50 lbs		Above 50lbs
	"On average, how much honey did the colonies you managed for honey production produce last year (in lbs. per colony)?" (numeric).					
	Justification: productivity in colonies is a sign of good health.					
4.2.3	**Crops (count)**	Don't know OR in the presence of 5+ crops		In the presence of 1-4 crops		None
	"Considering only the CROPS in flying range from your apiary(ies): Which of the following crops were the majority (>50%) of your colonies in proximity to when they were producing honey?" (multiple choice)					
	Options: None of the following crops ; Corn ; Sweet corn ; Cotton ; Cane crops (e.g., raspberries, blackberries, etc) ; Citrus ; Alfalfa ; Canola (rape) ; Soybeans ; Blueberries ; Cranberries ; Watermelons ; Cucumbers ; Other melons ; Squash ; Sunflowers ; I don't know.					
	Justification: the presence of crops could represent pesticide exposure.					
	DOMAIN 5: FEEDING					
5.1	**Feeding (Y/N)**	No				Yes
	"Last year (April 1, 2013 to April 1, 2014), did you feed or add a food substitute or stimulant to any of your colonies?" (single choice)					
5.1.1	**Feeding Products Type**	None	Supplements only	Proteins only OR Sugar only		Proteins and Sugars
	"Which, if any, of the following did you apply to any of your colonies between April 1, 2013 and April 1, 2014?" (multiple choice).					
	Options: None of the following ; Honey (capped frames) ; Protein patties ; Honey (excess extracted) ; Bee Pro ; Sugar (Sucrose) syrup ; Honey -B-Healthy ; High Fructose Corn ; Syrup (HFCS) ; Essential oil patties (e.g., LaFore patties) ; Candy (i.e., Fondant) ; Vitafeed Gold ; MegaBee ; Vitafeed Green.					
	Justification: a more complete supplementary diet is better.					
	Sugars: [Capped] [Honey] [Sucrose] [HFCS] [Candy] ; Proteins: [Prot.Patties] [BeePro] [MegaBee] ; Suppl.: [LaFore] [HBHealthy] [VitaGold] [VitaGreen]					
5.1.2	**Feeding (season)**					
	Northern States	Missing Information	Other time of the year	Spring OR Fall		Spring AND Fall
	Southern States	Missing Information		Once a year		Twice a year
	"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (selection, for each product).					
	Justification: feeding in critical periods in the states with winter season.					
	DOMAIN 6: MONITORING					
6.1	**General**					
6.1	**Boord Inspection (Freq)**	Never	Once OR Every 4 months	Every 2 months OR Every 3 months	Every month	Every 2 weeks or every week
	"Last year (April 1, 2013 to April 1, 2014), how frequently did you inspect your colonies to detect any brood disease in your colonies (visual inspection)?" (single choice)					
	Options: Never ; About once a year ; About once 4 months ; About once 3 months ; About once 2 months ; About once a month ; About twice a month ; About every week.					
	Justification: Frequency of insepction of brood chambers improves early reaction to health issues.					
6.2	**VARROA**					
6.2.1	**Varroa Monitoring (Freq)**	Never	Once OR Twice	Every 4 months	Every 2 months OR Every 3 months	Every month OR More than every month
	"Last year (April 1, 2013 to April 1, 2014), how often did you monitor VARROA mites in your colonies?" (single choice)					
	Options: I never checked for Varroa ; About once (very occasionally) ; About 2 times in the year ; About once every 4 months (~3 times in the year) ; About once every 3 months (~4 times in the year) ; About once every 2 months (~6 times in the year) ; About once a month (~12 times in the year) ; More than once a month.					
	Justification: Frequency increase method's efficiency.					
6.2.2	**Varroa Monitoring Technique**	Visual inspection of Bees	Visual inspection of drone brood	Ether roll	Mite drop or powdered sugar roll	Alcohol wash (and BIP samples and Other Lab)
	"If you did monitor for Varroa over the last year, which of the following techniques did you use?" (multiple choice)					
	Options: Visual inspection of adult bees ; Visual inspection of drone brood ; Mite drop (sticky boards or other collection tray below the hive) ; Powdered sugar roll ; Ether roll ; Alcohol wash ; Samples were collected by a Bee Informed Partnership Tech Transfer Team ; Samples were collected for another monitoring effort (National Honey Bee Survey or remote monitoring) ; I sent samples to another laboratory ; I did not monitor Varroa mites.					
	Justification: Method classified by increasing accuracy.					
6.3	**NOSEMA**					
6.3.1	**Nosema Monitoring (Freq)**	Never	Once OR Twice	Every 4 months	Every 2 months OR Every 3 months	Every month OR More than every month
	"Last year (April 1 2013 to April 1 2014), how often did you monitor/quantify NOSEMA levels in your colonies?" (single choice)					
	Options: I never checked for Nosema ; About once (very occasionally) ; About 2 times in the year ; About once every 4 months (~3 times in the year) ; About once every 3 months (~4 times in the year) ; About once every 2 months (~6 times in the year) ; About once a month (~12 times in the year) ; More than once a month.					
	Justification: Frequency increase method's efficiency.					
6.3.2	**Nosema Monitoring Technique**	Visual inspection				Microscope spore count (and BIP samples and Other Lab)
	"If you did monitor Nosema levels over the last year, which of the following techniques did you use?" (multiple choice)					
	Options: I looked for Nosema symptoms in and around the hive ; I took a sample and the bees were examined for spores with a microscope, but not in a professional lab ; Samples were collected by a Bee Informed Partnership Tech Transfer Team ; Samples were collected for another monitoring effort (National Honey Bee Survey or remote monitoring) ; I sent samples to another laboratory ; I did not monitor Nosema levels.					

ID	Criteria	0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	2 *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
	DOMAIN 7: VARROA CONTROL STRATEGIES					
7.1	**Non Chemical Strategies for VARROA**					
7.1	**Varroa IPM Practices (count)**	None used		1 method used		At least 2 methods used
	"Last year (April 1 2013 to April 1 2014), did you use any of the following IPM practices/ equipment to try to control VARROA MITES in your colonies?" (multiple choice) Options: I did not use any IPM practices or equipment ; Drone comb removal ; Small cell size comb ; Screened bottom board ; Powder sugar. *Justification: efficiency of control increase with variety of approaches.*					
7.1.1	**VARROA Drone Removal**					
7.1.1.1	**Drone Removal (Freq)**	Once or twice a year		Between 3 and 5 a year		Over 6 times a year (every 2 months)
	"On average, how many times did you remove drone brood from each of your colonies between April 1 2013 and April 1 2014?" (numeric) *Valid results: 1-48. Justification: Frequency increase method's efficiency.*					
7.1.1.2	**Drone Removal (PCol)**	Don't know OR 1 to 25 % of the colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
	"In what percentage of your colonies did you apply Drone brood removal?" (single choice) *Justification: partial control more likely to lose efficiency due to inter-hives contaminations.*					
7.1.1.3	**Drone Removal Amount**		Between the frames	About 1 shallow	About 1 medium	About 1 deep
	"How much capped drone brood did you remove, on average, each time you removed drone brood?" (single choice) Options: About the equivalent of a full deep frame of drone brood ; About the equivalent of a full medium frame of drone brood ; About the equivalent of a full shallow frame of drone brood ; Only drone brood built between frames/brood chambers in colonies. *Justification: intensity increase method's efficiency.*					
7.1.2	**VARROA Screened Bottom Board (SBB)**					
7.1.2.1	**SBB (PCol)**	Don't know OR 1 to25%	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
	"In what proportion of your operation did you use screened bottom boards?" (single choice) *Justification: partial control more likely to lose efficiency due to inter-hives contaminations.*					
7.1.2.2	**SBB (months)**					
	Northern states	< 5 months				>= 5 months
	Southern states	< 5 months		>= 5 months		All months
	"In which months did you have your screened bottom board engaged/open?" (selection) *Justification: yearlong control more efficient than punctual control.*					
7.1.3	**VARROA Powder Sugar**					
7.1.3	**Powder Sugar (months)**	< 5 months		>= 5 months		All months
	"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table) *Justification: yearlong control more efficient than punctual control.*					
7.2	**Chemical Strategies for VARROA**					
7.2	**Varroa Treatment (Y/N)**	No		Showing inconsistency with products question		Yes
	"Last year (April 1 2013 to April 1 2014), did you use a treatment to try to control VARROA MITES in your colonies?" (single choice) *Justification: incoherence between this question and the list of product shows misunderstanding of the product's function.*					
	Products used for VARROA	*Assumption: we assume the application of the product was done correctly (in accordance to the indications).*				
7.2.1	**Varroa Products Type (count)**					
	For OT = small-scale	1 product for Varroa				2 or more different products for Varroa
	For OT = professional	1 product for Varroa		2 different products for Varroa		3 or more different products for Varroa
	"Which, if any, of the following did you apply to any of your colonies between April 1, 2013 and April 1, 2014?" (multiple choice) *Justification: efficiency of control increase with variety of approaches and decrease risk of resistance.*					
7.2.2	**Varroa Products Applications (count)**					
	For OT = small-scale	1 treatment per year				2 or more treatments per year
	For OT = professional	1 treatment per year		2-3 treatments per year		4 or more treatments per year
	"Which, if any, of the following did you apply to any of your colonies between April 1, 2013 and April 1, 2014?" (multiple choice)					
7.2.3.1	**Fluvalinate use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table) *Justification: follows product's manufacturer recommendation.*				
7.2.3.2	**Fluvalinate use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table) *Justification: partial control more likely to lose efficiency due to inter-hives contaminations.*				

ID	Criteria	0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	2 *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
7.2.4.1	**Coumaphos (Varroa) use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
7.2.4.2	**Coumaphos (Varroa) use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.4.3	**Coumaphos (Varroa) use (count)**	More than 2 applications per year				1 or 2 applications per year
7.2.5.1	**Amitraz use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
7.2.5.2	**Amitraz use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.5.3	**Amitraz use (count)**	More than 2 applications per year				1 or 2 applications per year
7.2.6.1	**HopOil use (season)**	Winter				All but Winter
7.2.6.2	**HopOil use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.6.3	**HopOil use (count)**	More than 6 applications per year				1 to 6 applications per year
7.2.7.1	**Thymol use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
7.2.7.2	**Thymol use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.7.3	**Thymol use (count)**	More than 2 applications per year				1 or 2 applications per year
7.2.8.1	**Formic Acid use (season)**	Winter				All but Winter
7.2.8.2	**Formic Acid use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.9.1	**Oxalic Product use (season)**	Spring AND/OR Summer (minimum brood)				Fall AND/OR Winter
7.2.9.2	**Oxalic Product use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
7.2.10	**Contraindications**	Use of Fluvalinate AND Coumaphos in the same month				
						Justification: contraindicated .
	DOMAIN 8: NON-VARROA CONTROL STRATEGIES					
8.1	**Strategies for Small Hive Beetle (SHB)**					
8.1	**SHB Control Technique**					
	Region with SHB	None used				At least one method used
	Region without SHB	no impact on score				
	"Last year (April 1 2013 to April 1 2014), did you use any of the following techniques to try to control SMALL HIVE BEETLES in your colonies?" (multiple choice) Options: I did not use any technique to control SHB ; In-hive traps ; Soil drench ; Coumaphos strips ; Nematodes.					
	Justification: efficiency of control increase with variety of approaches.					
8.1.1	**If selected "trap"**					
8.1.1.1	**SHB Trap Type**	With poison				Physical trap or by drowning or diatomaceous earth
	"Which type of trap did you mostly (>50%) use?" (single choice) Options: a trap that traps SHB ; a trap that drowns SHB ; a trap that poisons SHB ; a trap with diatomaceous earth or lime.					
	Justification: poison methods introduce chemical in the hive.					
8.1.1.2	**SHB Bait Type**	Without bait				With bait
	"How did you bait the trap?" (multiple choice) Options: No bait ; Apple cider vinegar ; Mineral oil ; Cooking oil / vegetable oil ; Honey and/or pollen patty.					
	Justification: baits increase efficiency of trap. Assumption: all baits equally efficient at attracting SHB.					
8.1.1.3	**SHB Trap use (month)**	< 5 months		>= 5 months		All months
	"In which months did you have used small hive beetle traps in your colonies?" (selection).					
	Justification: yearlong control more efficient than punctual control.					
8.1.2	**If selected "soil drench"**					
8.1.2	**SHB Soil Drench use (month&PCol)**	Not all colonies AND < 5 months		Not all colonies OR not >=5 months		All Colonies, >= 5 months
	"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):"(table).					
	Justification: yearlong control more efficient than punctual control AND partial control more likely to lose efficiency due to inter-hives contaminations.					
8..1.3	**If selected "Coumaphos" for SHB**	*Assumption: we assume the application of the product was done correctly (in accordance to the indications).*				
8.1.3.1	**Coumaphos (SHB) use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
8.1.3.2	**Coumaphos (SHB) use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	76 to 99%	100% of the colonies
8.1.3.3	**Coumaphos (SHB) use (count)**	More than 2 applications per year				1 or 2 applications per year

ID	Criteria	0 *Greatly decreased chance of survivorship*	1 *Slightly decreased chance of survivorship*	**2** *No effect on survivorship*	3 *Slightly increased chance of survivorship*	4 *Greatly increased chance of survivorship*
8.2	**Strategies for NOSEMA**					
8.2.1	**Nosema Treatment (Y/N)**	No		Showing inconsistency with products question		Yes
	"Last year (April 1 2013 to April 1 2014), did you use a treatment to try to control NOSEMA in your colonies?" (single choice)					
						Justification: incoherence between this question and the list of product shows misunderstanding of the product's function.
8.2.2	**Products used for NOSEMA**		*Assumption: we assume the application of the product was done correctly (in accordance to the indications).*			
8.2.2.1	**Nosema Products Applications (count)**	More than 2 treatments per year		1 treatment per year		2 treatments per year
	"Which, if any, of the following did you apply to any of your colonies between April 1, 2013 and April 1, 2014?" (multiple choice)					
8.2.2.2.1	**Fumagillin use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table)				
						Justification: Frequency increase method's efficiency.
8.2.2.2.2	**Fumagillin use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table)				
						Justification: partial control more likely to lose efficiency due to inter-hives contaminations.
8.2.2.3.1	**Nozevit use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
8.2.2.3.2	**Nozevit use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
8.3	**Strategies for Foul Brood (FB)**					
8.3.1.1	**Terramycin use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table)				
						Justification: Frequency increase method's efficiency.
8.3.1.2	**Terramycin use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
		"Please specify how and when you used this product in the last year (April 1 2013-April 1 2014):" (table)				
						Justification: partial control more likely to lose efficiency due to inter-hives contaminations.
8.3.2.1	**Tylosin use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
8.3.2.2	**Tylosin use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
8.3.3	**FB Treatment (motive)**	As part of regular colony maintenance				In response to observed pest outbreaks OR lab test results OR pest outbreaks in the local area
	"Why did you use the product:" (table, 1 answer for each month use) Options: As part of my regular colony maintenance ; In response to observed pest outbreaks ; In response to lab test results that indicate pest outbreak ; In response to pest outbreaks in the local area.					
						Justification: global IPM strategy should not include calendar treatments when the pest is absent.
8.4	**Strategies for TRACHEAL MITES (TM)**					
8.4.1.1	**MiteAThol use (season)**	Summer (honey flow) AND/OR Winter (too cold)				Spring AND/OR Fall
8.4.1.2	**MiteAThol use (PCol)**	No information or Less than 25% colonies	26 to 50%	51 to 75%	75 to 99%	100% of the colonies
8.4.2	**TM Treatment (motive)**	As part of regular colony maintenance				In response to observed pest outbreaks OR lab test results OR pest outbreaks in the local area
	"Why did you use the product:" (table, 1 answer for each month use) Options: As part of my regular colony maintenance ; In response to observed pest outbreaks ; In response to lab test results that indicate pest outbreak ; In response to pest outbreaks in the local area.					
						Justification: global IPM strategy should not include calendar treatments when the pest is absent.

Appendix 7. *Summary of criteria scoring, expert's weighting and validation*

		Criteria Scoring (before imputation)								Experts' average points by Criteria and Domains		Criteria Weights			
	Criteria	Score_0	Score_1	Score_2	Score_3	Score_4	NRA	Missing	Domains	Av CP	Av DP	CW	CW StdErr	CW Rank	Validation
1	Years of Beekeeping	64	2,888	6,587	5,919	2,528	0	985	Beekeeper	14.14	11.21	13.74	3.08	19	NA
2	Sources of Information (count)	0	4,015	9,709	3,551	764	0	932	Beekeeper	7.14	11.21	7.85	2.85	55	NA
3	Beekeeping Education	0	2,806	10,786	985	3,115	0	1,279	Beekeeper	8.71	11.21	7.66	1.66	57	NA
4	Equipment Type	856	42	1,198	0	15,703	0	1,172	Equipment	6.14	6.36	3.16	0.62	81	NA
5	Foundation Type	1,347	0	4,586	0	3,698	8,641	699	Equipment	5.50	6.36	3.56	0.89	79	NA
6	Average Comb Age	442	2,732	1,184	5,920	3,818	3,796	1,079	Equipment	10.86	6.36	6.17	1.34	65	NA
7	October Brood Chamber Size	1,176	0	4,915	3,853	7,193	314	1,520	Equipment	13.29	6.36	7.60	1.99	58	NA
8	Comb Culling and Storage Technique	129	2,043	3,894	4,443	7,112	54	1,296	Equipment	11.07	6.36	6.14	1.13	66	NA
9	Action on Deadouts	7,705	0	2,949	0	767	4,693	2,857	Equipment	5.86	6.36	3.06	0.53	82	NA
10	Winter Preparation Technique	1,450	2,862	4,694	4,416	3,983	0	1,566	Equipment	17.29	6.36	9.18	2.11	45	NA
11	Average Queen Age	1,806	761	2,799	6,189	6,754	0	662	Queens & Increases	14.29	15.86	19.13	2.95	10	NA
12	Queens Replaced (Y/N)	9,994	0	0	0	8,250	0	727	Queens & Increases	13.43	15.86	18.28	2.74	11	NA
13	Queens Replaced (PCol)	174	2,353	3,705	648	1,190	10,721	180	Queens & Increases	12.21	15.86	15.81	2.50	15	NA
14	ReQueening Technique	74	3,388	1,258	3,235	100	10,721	195	Queens & Increases	6.71	15.86	8.67	1.10	49	NA
15	Queen Source	20	0	889	4,061	1,184	12,511	306	Queens & Increases	6.79	15.86	9.99	3.09	38	NA
16	Started New Cols (Y/N)	4,213	0	0	0	14,057	0	701	Queens & Increases	9.21	15.86	13.35	4.24	22	NA
17	New Colonies Technique	6,583	4,165	2,022	166	2,394	0	3,641	Queens & Increases	7.36	15.86	9.91	2.03	41	NA
18	Moved across state lines (Y/N)	598	0	0	0	17,896	0	477	Seasonal	6.43	7.71	3.38	0.90	80	NA
19	Moved across state lines (PCol)	0	270	57	112	97	18,054	381	Seasonal	7.21	7.71	4.95	1.81	71	Excluded (1)
20	States (count)	8	0	49	0	417	18,373	124	Seasonal	7.14	7.71	4.13	0.85	77	NA
21	Honey Produced (lbs)	3,582	0	5,742	0	4,871	3,330	1,446	Seasonal	14.07	7.71	10.89	3.62	33	NA
22	Honey Harvest (Y/N)	3,625	0	657	0	13,467	0	1,222	Seasonal	8.86	7.71	7.03	2.98	60	NA
23	Crops (count)	3,392	0	5,545	0	2,423	4,847	2,764	Seasonal	16.29	7.71	10.47	2.96	35	NA
24	Feeding (Y/N)	1,206	0	0	0	17,068	0	697	Feeding	11.14	13.07	12.42	2.37	26	NA
25	Feeding Products Type	1,253	377	9,564	0	6,976	0	801	Feeding	10.07	13.07	10.18	1.14	37	NA
26	Feeding (season)	0	879	5,962	0	8,662	2,207	1,261	Feeding	8.79	13.07	10.47	2.24	34	NA
27	Brood Inspection (Freq)	1,120	1,559	1,905	3,183	2,563	8,641	0	Monitoring	14.29	13.00	14.37	1.53	18	NA
28	Varroa Monitoring (Freq)	1,681	3,973	996	1,801	1,879	8,641	0	Monitoring	15.86	13.00	17.49	2.47	13	NA
29	Varroa Monitoring Technique	5,002	2,743	162	9,431	746	0	887	Monitoring	9.14	13.00	9.99	1.52	39	NA
30	Nosema Monitoring (Freq)	13,027	3,025	628	851	1,194	0	246	Monitoring	5.21	13.00	6.05	1.28	68	NA
31	Nosema Monitoring Technique	7,197	0	0	0	525	8,641	2,608	Monitoring	5.50	13.00	6.44	1.44	63	NA
32	Varroa IPM Practices (count)	2,691	0	9,565	0	4,458	0	2,257	Varroa Control	18.14	23.71	34.90	6.02	4	NA
33	Drone Removal (Freq)	1,743	0	873	0	301	15,937	117	Varroa Control	7.14	23.71	13.32	1.70	23	NA
34	Drone Removal (PCol)	819	261	374	242	1,290	15,937	48	Varroa Control	6.36	23.71	11.94	2.00	28	NA
35	Drone Removal Amount	0	530	390	653	1,083	15,937	378	Varroa Control	5.29	23.71	9.52	1.29	44	NA
36	SBB (PCol)	622	311	1,214	667	10,022	5,971	164	Varroa Control	7.07	23.71	13.22	1.92	24	NA
37	SBB (months)	998	0	1,136	0	10,560	5,971	306	Varroa Control	6.07	23.71	11.60	2.38	29	NA
38	Powder Sugar use (months)	1,746	0	221	0	14	16,763	227	Varroa Control	4.57	23.71	8.04	1.51	51	NA
39	Varroa Treatment (Y/N)	8,743	0	1,314	0	8,427	0	487	Varroa Control	39.64	23.71	77.01	14.93	1	NA
40	Varroa Products Type (count)	5,011	0	224	0	4,141	9,595	0	Varroa Control	16.57	23.71	31.28	4.98	5	NA
41	Varroa Products Applications (count)	4,704	0	341	0	2,144	11,317	465	Varroa Control	19.43	23.71	38.62	6.80	2	NA
42	Fluvalinate use (season)	76	0	0	0	336	18,521	38	Varroa Control	6.14	23.71	11.10	2.29	32	NA
43	Fluvalinate use (PCol)	67	17	30	6	295	18,521	35	Varroa Control	5.36	23.71	9.61	1.96	43	NA
44	Coumaphos (Varroa) use (season)	39	0	0	0	148	18,761	23	Varroa Control	6.14	23.71	11.34	3.21	30	NA
45	Coumaphos (Varroa) use (count)	11	0	0	0	176	18,761	23	Varroa Control	4.43	23.71	7.76	2.13	56	Excluded (2)
46	Coumaphos (Varroa) use (PCol)	30	10	13	0	126	18,761	31	Varroa Control	4.43	23.71	7.86	1.84	54	NA
47	Contraindications	13	0	0	0	14	18,943	1	Varroa Control	5.64	23.71	9.92	3.18	40	Excluded (2)
48	Amitraz use (season)	147	0	0	0	456	18,298	70	Varroa Control	17.86	23.71	35.27	6.26	3	NA
49	Amitraz use (count)	84	0	0	0	519	18,298	70	Varroa Control	15.07	23.71	29.10	7.60	6	NA
50	Amitraz use (PCol)	52	47	41	21	427	18,298	85	Varroa Control	11.71	23.71	22.02	3.12	9	NA
51	Hop Oil use (season)	27	0	0	0	862	18,011	71	Varroa Control	6.93	23.71	12.99	2.21	25	Excluded (2)
52	Hop Oil use (count)	4	0	0	0	885	18,011	71	Varroa Control	5.29	23.71	9.76	2.47	42	Excluded (2)
53	Hop Oil use (PCol)	133	67	80	8	592	18,011	80	Varroa Control	4.93	23.71	8.86	1.28	47	NA
54	Thymol use (season)	858	0	0	0	2,123	15,757	233	Varroa Control	9.43	23.71	17.85	2.32	12	NA
55	Thymol use (count)	90	0	0	0	2,891	15,757	233	Varroa Control	7.29	23.71	13.60	2.08	21	NA
56	Thymol use (PCol)	371	150	230	29	2,133	15,757	301	Varroa Control	7.57	23.71	13.74	1.48	20	NA
57	Formic Acid use (season)	31	0	0	0	3,006	15,734	200	Varroa Control	11.93	23.71	22.66	3.07	7	NA
58	Formic Acid use (PCol)	399	209	306	56	2,052	15,734	215	Varroa Control	9.36	23.71	17.19	1.99	14	NA
59	Oxalic Acid use (season)	107	0	0	0	469	18,335	60	Varroa Control	11.64	23.71	22.32	3.04	8	NA
60	Oxalic Acid use (PCol)	61	32	42	12	422	18,335	67	Varroa Control	8.57	23.71	15.62	1.66	16	NA
61	SHB Control Technique	3,052	0	0	0	3,221	10,847	1,851	Non-Varroa Control	15.64	9.07	10.24	0.90	36	NA
62	SHB Trap Type	133	0	0	0	2,160	15,518	1,160	Non-Varroa Control	10.64	9.07	7.87	1.21	53	Excluded (1)
63	SHB Bait Type	212	0	0	0	2,385	15,518	856	Non-Varroa Control	8.14	9.07	6.24	0.96	64	NA
64	SHB Trap use (month)	805	0	593	0	1,263	15,518	792	Non-Varroa Control	8.64	9.07	6.74	1.29	61	NA
65	SHB Soil Drench use (month&PCol)	38	0	186	0	51	18,657	39	Non-Varroa Control	7.50	9.07	5.83	0.99	69	NA
66	Coumaphos (SHB) use (season)	17	0	0	0	48	18,883	23	Non-Varroa Control	6.86	9.07	5.31	1.13	70	Excluded (2)
67	Coumaphos (SHB) use (count)	10	0	0	0	55	18,883	23	Non-Varroa Control	6.00	9.07	4.57	0.95	73.5	Excluded (2)
68	Coumaphos (SHB) use (PCol)	16	3	2	2	42	18,883	23	Non-Varroa Control	6.00	9.07	4.57	0.95	73.5	NA
69	Nosema Treatment (Y/N)	14,035	0	981	0	3,468	0	487	Non-Varroa Control	14.79	9.07	11.29	2.16	31	NA
70	Nosema Products Applications (count)	267	0	2,164	0	964	15,301	275	Non-Varroa Control	10.71	9.07	8.83	2.23	48	NA
71	Fumagilin use (season)	188	0	0	0	3,042	15,478	263	Non-Varroa Control	10.57	9.07	7.94	1.40	52	NA
72	Fumagilin use (PCol)	266	70	188	12	2,706	15,478	251	Non-Varroa Control	8.29	9.07	6.65	1.40	62	NA
73	Nozevit use (season)	37	0	0	0	226	18,688	20	Non-Varroa Control	5.21	9.07	4.36	1.14	76	NA
74	Nozevit use (PCol)	23	8	34	1	201	18,688	16	Non-Varroa Control	4.50	9.07	3.70	0.92	78	NA
75	Terramycin use (season)	170	0	0	0	1,007	17,643	151	Non-Varroa Control	17.07	9.07	12.25	3.20	27	NA
76	Terramycin use (PCol)	136	22	76	7	959	17,643	128	Non-Varroa Control	11.29	9.07	8.16	1.58	50	NA
77	Tylosin use (season)	46	0	0	0	242	18,617	66	Non-Varroa Control	10.21	9.07	7.20	0.96	59	NA
78	Tylosin use (PCol)	37	7	19	2	230	18,617	59	Non-Varroa Control	8.29	9.07	6.10	0.92	67	NA
79	FB Treatment (motive)	526	0	0	0	125	17,395	925	Non-Varroa Control	24.00	9.07	14.61	3.62	17	Excluded (1)
80	MiteAThol use (season)	49	0	0	0	208	18,656	58	Non-Varroa Control	6.21	9.07	4.58	0.85	72	NA
81	MiteAThol use (PCol)	31	6	18	0	200	18,656	60	Non-Varroa Control	5.86	9.07	4.43	0.90	75	NA
82	TM Treatment (motive)	102	0	0	0	14	18,656	199	Non-Varroa Control	13.57	9.07	8.90	1.93	46	Excluded (1)

Legend: PCol (percent colony), Freq (frequency), SHB (Small Hive Beetle), FB (Foulbrood), TM (Tracheal mites).
Excluded (1): below 70% response rate; Excluded (2): no minimum 2 levels of 30 selections

Appendix 8. *<u>Bootstrapped sensitivity analyses of the 72 component criteria of General Management Index's correlation to Standardized Winter Loss. Imputation method "mean"; no weight; b=10,000 bootstrap resamples.</u>*

Criteria	Subset = All, N=18,981								Subset = S.No., N=11,630							
	Or. Rank	b.mean	b.bias	b.median	b.sd	b. 95% CI	RootMSE	MAE	Or. Rank	b.mean	b.bias	b.median	b.sd	b. 95% CI	RootMSE	MAE
Action on Deadouts	1	1.00	0.00	1.00	0.00	[1-1]	0.00	0.00	1	1.00	0.00	1.00	0.00	[1-1]	0.00	0.00
New Colonies Technique	2	2.09	0.09	2.00	0.28	[2-3]	0.29	0.09	3	3.00	0.00	3.00	0.02	[3-3]	0.02	0.00
Varroa Treatment (Y/N)	3	2.92	-0.09	3.00	0.28	[2-3]	0.29	0.09	2	2.00	0.00	2.00	0.02	[2-2]	0.02	0.00
Comb Culling and Storage Technique	4	4.48	0.48	4.00	0.52	[4-5]	0.71	0.48	4	4.36	0.36	4.00	0.83	[4-7]	0.90	0.36
Winter Preparation Technique	5	4.55	-0.45	5.00	0.55	[4-5]	0.71	0.50	45	39.39	-5.61	43.00	16.07	[14-62]	17.02	14.59
Crops (count)	6	6.74	0.74	7.00	1.06	[6-10]	1.29	0.76	9	8.96	-0.04	9.00	3.00	[5-16]	3.00	2.36
Varroa Products Type (count)	7	6.87	-0.13	7.00	1.25	[6-10]	1.26	0.80	6	6.74	0.74	6.00	2.53	[4-13]	2.64	1.82
Powder Sugar use (month)	8	9.41	1.41	9.00	1.60	[7-13]	2.13	1.57	7	8.06	1.06	8.00	1.72	[5-12]	2.02	1.52
Thymol use (count)	9	9.81	0.81	10.00	1.38	[8-13]	1.60	1.20	8	8.22	0.22	8.00	1.46	[6-11]	1.48	1.11
Honey Produced (lbs)	10	10.81	0.81	10.00	4.09	[6-21]	4.17	2.83	23	29.55	6.55	24.00	15.27	[11-59]	16.62	12.44
Formic Acid use (season)	11	10.03	-0.97	10.00	1.43	[7-13]	1.73	1.36	5	5.73	0.73	6.00	1.11	[4-8]	1.33	0.89
Average Comb Age	12	13.70	1.70	13.00	4.76	[8-26]	5.05	3.20	16	16.94	0.94	15.00	7.29	[9-41]	7.35	4.52
Formic Acid use (PCol)	13	13.12	0.12	13.00	1.70	[10-17]	1.70	1.25	10	10.25	0.25	10.00	1.91	[7-14]	1.93	1.45
SHB Control Technique	14	15.51	1.51	14.00	5.68	[8-31]	5.88	3.67	64	62.70	-1.30	63.00	3.33	[55-67]	3.58	2.49
Thymol use (PCol)	15	15.47	0.47	15.00	2.24	[12-21]	2.29	1.64	14	14.52	0.52	14.00	2.19	[11-19]	2.26	1.75
SHB Trap use (month)	16	16.89	0.89	16.00	3.46	[12-25]	3.57	2.46	30	35.84	5.84	34.00	9.80	[20-53]	11.40	9.04
SBB (PCol)	17	19.39	2.39	17.00	8.20	[10-44]	8.54	5.52	13	15.14	2.14	14.00	5.71	[8-29]	6.10	3.75
Queens Replaced (PCol)	18	18.05	0.05	17.00	4.20	[12-28]	4.20	3.11	15	14.86	-0.14	15.00	2.75	[10-21]	2.75	2.06
Amitraz use (PCol)	19	18.83	-0.17	19.00	1.75	[16-22]	1.76	1.37	24	24.26	0.26	24.00	2.31	[20-29]	2.33	1.81
Amitraz use (count)	20	19.33	-0.67	19.00	1.86	[16-23]	1.97	1.54	21	22.29	1.29	22.00	2.26	[18-27]	2.60	2.05
States (count)	21	21.54	0.54	22.00	2.03	[18-26]	2.10	1.62	29	32.12	3.12	31.00	4.63	[25-43]	5.58	4.14
Drone Removal (Freq)	22	24.37	2.37	23.00	6.97	[15-43.02]	7.36	5.23	31	36.41	5.41	35.00	11.69	[18-56]	12.88	10.69
Oxalic Acid use (season)	23	23.59	0.59	24.00	2.25	[19-28]	2.33	1.77	19	20.28	1.28	20.00	2.32	[16-25]	2.65	1.98
SHB Bait Type	24	25.25	1.25	24.00	7.08	[16-44]	7.19	5.22	48	44.86	-3.14	47.00	8.78	[25-57]	9.32	6.84
Oxalic Acid use (PCol)	25	24.30	-0.70	24.00	2.24	[20-29]	2.35	1.82	20	21.55	1.55	21.00	2.47	[17-27]	2.92	2.23
Amitraz use (season)	26	27.41	1.41	27.00	3.02	[22-35]	3.33	2.43	37	37.28	0.28	37.00	5.81	[27-48]	5.81	4.90
Fluvalinate use (PCol)	27	27.67	0.67	27.00	3.25	[22-35]	3.32	2.46	26	27.61	1.61	27.00	3.83	[21-38]	4.15	2.93
Tylosin use (PCol)	28	29.76	1.76	29.50	2.60	[25-35]	3.14	2.39	39	37.58	-1.42	38.00	4.18	[29-45]	4.42	3.54
Coumaphos (Varroa) use (PCol)	29	30.87	1.87	31.00	2.82	[26-37]	3.39	2.61	36	36.56	0.56	36.00	4.58	[28-45]	4.61	3.79
Coumaphos (SHB) use (PCol)	30	32.02	2.02	32.00	2.22	[28-37]	2.99	2.39	33	35.44	2.44	35.00	2.88	[30-41]	3.78	3.02
Drone Removal (PCol)	31	34.00	3.00	33.00	8.66	[20-50]	9.17	7.52	44	40.83	-3.17	43.00	10.73	[21-57]	11.19	9.25
MiteAThol use (PCol)	32	34.02	2.02	34.00	3.91	[27-42]	4.40	3.45	28	31.90	3.90	31.00	4.98	[25-44]	6.32	4.62
Coumaphos (Varroa) use (season)	33	34.63	1.63	35.00	3.43	[28-42]	3.80	3.00	35	36.49	1.49	36.00	4.88	[28-46]	5.10	4.18
Nosema Monitoring Technique	34	36.54	2.54	37.00	13.27	[15-57]	13.51	11.99	11	12.67	1.67	12.00	4.50	[6-23]	4.79	3.16
MiteAThol use (season)	35	37.58	2.58	38.00	4.03	[30-45]	4.78	3.84	40	39.81	-0.19	40.00	5.60	[29-49]	5.60	4.60
Fluvalinate use (season)	36	38.13	2.13	38.00	4.76	[29-47]	5.21	4.27	42	39.84	-2.16	41.00	6.37	[28-50]	6.73	5.44
Drone Removal Amount	37	37.99	0.99	39.00	6.95	[25-50]	7.02	5.96	27	32.52	5.52	30.00	8.44	[20-50]	10.08	7.40
Tylosin use (season)	38	38.50	0.50	38.00	3.14	[33-45]	3.18	2.54	43	42.72	-0.28	43.00	3.20	[36-48]	3.22	2.52
Nozevit use (PCol)	39	39.24	0.24	39.00	3.48	[32-46]	3.49	2.81	41	40.06	-0.94	41.00	4.85	[30-48]	4.94	3.94
SHB Soil Drench use (month&PCol)	40	40.51	0.51	41.00	2.88	[35-46]	2.93	2.34	32	35.34	3.34	35.00	3.25	[29-42]	4.66	3.78
Nozevit use (season)	41	40.43	-0.57	41.00	3.42	[33-46]	3.47	2.73	47	44.24	-2.76	45.00	3.97	[35-51]	4.83	3.62
Queen Source	42	40.22	-1.78	41.00	6.30	[27-50]	6.55	5.18	49	45.66	-3.34	47.00	7.08	[28-55]	7.83	5.46
Foundation Type	43	42.04	-0.96	45.00	11.77	[18-59]	11.81	9.88	25	29.77	4.77	26.00	13.07	[14-56]	13.91	10.48
Terramycin use (season)	44	44.34	0.34	45.00	5.06	[32-52]	5.07	3.93	38	37.39	-0.61	37.00	8.08	[24-51]	8.10	7.05
Nosema Products Applications (count)	45	44.91	-0.09	46.00	5.50	[31-53]	5.50	4.15	51	48.76	-2.24	50.00	6.57	[30-57]	6.94	4.72
Sources of Information (count)	46	45.04	-0.96	47.00	9.07	[24-58]	9.12	7.05	50	46.09	-3.91	50.00	11.03	[21-60]	11.71	8.49
Fumagilin use (PCol)	47	46.82	-0.18	48.00	6.46	[30-56]	6.46	4.87	46	41.49	-4.51	45.00	10.48	[22-56]	11.40	8.99
Terramycin use (PCol)	48	48.57	0.57	49.00	3.67	[40-55]	3.72	2.86	53	51.81	-1.19	52.00	3.97	[42-58]	4.15	2.98
Hop Oil use (PCol)	49	49.68	0.68	50.00	2.94	[44-55]	3.02	2.39	52	51.18	-0.82	52.00	3.88	[42-57]	3.97	2.85
Equipment Type	50	47.74	-2.26	51.00	10.78	[22-62]	11.01	8.16	18	20.79	2.79	18.00	9.17	[11-50]	9.59	5.76
Thymol use (season)	51	52.41	1.41	53.00	4.68	[41-60]	4.89	3.86	58	56.37	-1.63	57.00	4.35	[46-62]	4.65	3.03
Moved across state lines (Y/N)	52	53.35	1.35	54.00	4.01	[44-60]	4.23	3.35	22	24.63	2.63	23.00	6.31	[17-43]	6.83	4.63
Beekeeping Education	53	52.41	-0.59	54.00	7.67	[30-62]	7.69	5.50	56	53.66	-2.34	56.00	8.92	[26-63]	9.22	5.82
SBB (months)	54	51.88	-2.12	54.00	9.59	[25-63]	9.83	6.81	17	19.60	2.60	17.00	9.75	[9-51]	10.09	6.05
Queens Replaced (Y/N)	55	49.88	-5.12	55.00	14.57	[15-66]	15.44	10.90	65	60.56	-4.44	63.00	9.86	[25-69]	10.82	5.95
Years of Beekeeping	56	53.36	-2.64	55.00	7.59	[30-63]	8.03	5.34	59	55.74	-3.26	58.00	7.56	[31-64]	8.23	5.01
October Brood Chamber Size	57	54.18	-2.82	56.00	8.36	[29-64]	8.82	5.83	12	13.40	1.40	12.00	5.61	[6-27]	5.78	3.60
Honey Harvest (Y/N)	58	52.75	-5.25	57.00	12.67	[19-66]	13.72	8.99	54	48.46	-5.54	55.00	16.40	[14-67]	17.31	12.62
Feeding (season)	59	55.63	-3.37	57.00	6.80	[36.98-64]	7.59	5.05	70	70.70	0.70	71.00	1.07	[68-72]	1.28	1.01
Fumagilin use (season)	60	58.09	-1.91	58.00	2.57	[52-62]	3.21	2.44	55	54.86	-0.14	56.00	4.41	[44-61]	4.41	3.05
Varroa IPM Practices (count)	61	57.79	-3.21	59.00	6.24	[41-65]	7.01	4.45	34	36.67	2.67	35.00	15.35	[14.98-60]	15.58	14.06
ReQueening Technique	62	60.47	-1.53	61.00	2.27	[55-64]	2.74	2.01	61	61.78	0.78	62.00	2.17	[57-66]	2.30	1.82
Nosema Treatment (Y/N)	63	62.42	-0.58	63.00	4.23	[51.98-68]	4.27	2.73	57	51.81	-5.19	57.00	13.46	[18-66]	14.42	9.32
Started New Cols (Y/N)	64	62.60	-1.40	64.00	6.41	[46-70]	6.56	3.79	63	60.23	-2.77	63.00	9.85	[25.98-69]	10.23	5.79
Varroa Monitoring Technique	65	63.31	-1.69	64.00	3.81	[54-69]	4.17	2.64	66	63.78	-2.22	65.00	4.42	[54-69]	4.94	3.13
Feeding Products Type	66	66.77	0.77	67.00	2.10	[63-71]	2.24	1.74	60	56.76	-3.24	59.00	8.47	[29-65]	9.07	5.34
Varroa Products Applications (count)	67	66.89	-0.11	67.00	1.89	[63-71]	1.89	1.48	71	70.72	-0.28	71.00	1.08	[68-72]	1.11	0.84
Varroa Monitoring (Freq)	68	67.07	-0.93	67.00	1.82	[64-71]	2.04	1.60	62	62.33	0.33	63.00	3.45	[54-67]	3.46	2.54
Brood Inspection (Freq)	69	68.59	-0.41	69.00	1.66	[65-72]	1.71	1.30	68	67.18	-0.82	67.00	1.54	[64-70]	1.75	1.23
Nosema Monitoring (Freq)	70	70.20	0.20	71.00	1.63	[66-72]	1.65	1.29	72	70.97	-1.03	71.00	1.11	[68.98-72]	1.51	1.03
Average Queen Age	71	70.50	-0.50	71.00	1.67	[66-72]	1.74	1.21	69	68.53	-0.47	69.00	1.79	[64-72]	1.85	1.24
Feeding (Y/N)	72	70.77	-1.23	71.00	1.28	[68-72]	1.78	1.23	67	66.42	-0.58	67.00	2.00	[62-69]	2.09	1.49

Criteria	Subset = S.So., N=6,411								Subset = Pr.S., N=596								Subset = Pr.M., N=334							
	Or. Rank	b.mean	b.bias	b.median	b.sd	b. 95% CI	RootMSE	MAE	Or. Rank	b.mean	b.bias	b.median	b.sd	b. 95% CI	RootMSE	MAE	Or. Rank	b.mean	b.bias	b.median	b.sd	b. 95% CI	RootMSE	MAE
Action on Deadouts	1	1.00	0.00	1.00	0.00	[1-1]	0.00	0.00	46	42.90	-5.10	47.00	19.53	[8-69]	20.19	17.08	9	19.43	10.43	14.00	16.66	[2-62]	19.65	13.06
New Colonies Technique	2	2.03	0.03	2.00	0.17	[2-3]	0.17	0.03	1	1.00	0.00	1.00	0.05	[1-1]	0.05	0.00	4	10.49	6.49	4.00	14.33	[1-58]	15.73	8.23
Varroa Treatment (Y/N)	3	3.35	0.35	3.00	1.05	[2-6]	1.11	0.41	5	10.42	5.42	6.00	12.87	[2-55]	13.96	7.31	31	35.56	4.56	32.00	23.05	[3-71]	23.49	20.71
Comb Culling and Storage Technique	5	4.69	-0.31	5.00	1.05	[3-7]	1.10	0.80	18	23.02	5.02	18.00	14.73	[6-59]	15.56	11.28	16	21.54	5.54	18.00	15.11	[3-59]	16.09	11.57
Winter Preparation Technique	12	19.80	7.80	15.00	11.83	[8-51]	14.17	8.97	10	14.19	4.19	11.00	11.17	[3-48.02]	11.93	7.48	3	5.73	2.73	4.00	5.25	[1-20]	5.92	3.06
Crops (count)	6	6.37	0.37	6.00	2.23	[4-11]	2.26	1.21	15	20.37	5.37	16.00	13.23	[5-55]	14.28	9.78	13	20.06	7.06	17.00	13.64	[4-55]	15.36	10.69
Varroa Products Type (count)	8	10.73	2.73	9.00	7.07	[5-35]	7.58	3.67	4	6.73	2.73	5.00	5.75	[2-22]	6.36	3.39	26	33.50	7.50	28.00	23.18	[2-71]	24.37	20.57
Powder Sugar use (month)	22	26.41	4.41	22.00	12.90	[10-53]	13.63	10.46	22	24.73	2.73	23.00	8.16	[12-45]	8.60	6.43	22	23.87	1.87	23.00	7.06	[12-41]	7.31	5.51
Thymol use (count)	11	12.45	1.45	12.00	3.18	[8-20]	3.50	2.27	29	31.59	2.59	30.00	11.81	[14-56]	12.09	9.76	27	32.58	5.58	30.00	15.69	[9-62]	16.65	13.43
Honey Produced (lbs)	4	4.80	0.80	5.00	1.47	[3-8]	1.67	1.05	2	3.01	1.01	2.00	1.88	[2-8]	2.14	1.01	1	2.95	1.95	2.00	3.31	[1-12]	3.84	1.95
Formic Acid use (season)	15	17.02	2.02	16.00	5.09	[10-30]	5.47	3.74	35	35.60	0.60	34.00	13.62	[13-60.02]	13.63	11.64	69	60.54	-8.46	63.00	9.26	[34-71]	12.55	8.82
Average Comb Age	9	10.95	1.95	9.00	7.44	[5-37]	7.69	3.77	63	56.21	-6.79	60.00	12.14	[23-70]	13.90	9.19	23	28.82	5.82	25.00	17.57	[5-65]	18.51	14.60
Formic Acid use (PCol)	18	19.06	1.06	18.00	6.74	[10-38]	6.82	4.78	19	21.86	2.86	19.00	11.46	[7-51]	11.81	8.60	20	23.22	3.22	21.00	12.24	[6-52]	12.66	9.42
SHB Control Technique	10	12.70	2.70	10.00	8.97	[6-44]	9.37	4.96	13	18.13	5.13	14.00	12.53	[4-53]	13.54	8.97	59	54.02	-4.98	58.00	14.77	[19-71]	15.59	11.54
Thymol use (PCol)	16	18.08	2.08	17.00	6.79	[10-38]	7.10	4.74	20	25.15	5.15	22.00	11.92	[9-53]	12.99	9.56	18	21.99	3.99	20.00	10.59	[7-49]	11.32	8.11
SHB Trap use (month)	7	9.57	2.57	9.00	3.94	[6-20]	4.71	2.74	12	15.64	3.64	14.00	6.94	[6-34]	7.83	5.47	28	30.75	2.75	30.00	7.44	[18-47]	7.93	6.04
SBB (PCol)	43	36.98	-6.02	41.00	17.44	[9-62]	18.45	15.79	11	17.24	6.24	13.00	12.90	[4-55]	14.33	9.25	7	13.20	6.20	12.00	7.11	[4-31]	9.44	6.85
Queens Replaced (PCol)	45	41.36	-3.64	45.00	12.73	[16-59]	13.24	10.49	25	30.66	5.66	27.00	14.83	[9-60]	15.88	12.53	15	20.32	5.32	17.00	13.65	[4-56]	14.66	10.28
Amitraz use (PCol)	23	23.95	0.95	23.00	4.06	[17-34]	4.17	3.11	8	10.61	2.61	10.00	3.01	[6-17.02]	3.99	3.04	6	13.67	7.67	11.00	9.51	[3-42]	12.22	8.28
Amitraz use (count)	14	15.99	1.99	16.00	2.39	[12-21]	3.11	2.46	36	36.32	0.32	35.00	12.19	[16-59]	12.19	10.37	25	32.57	7.57	28.00	19.25	[5-69]	20.68	16.66
States (count)	20	20.86	0.86	21.00	3.44	[15-29]	3.54	2.63	31	32.74	1.74	32.00	8.27	[19-50]	8.45	6.71	14	20.51	6.51	16.00	14.83	[3-58]	16.20	11.34
Drone Removal (Freq)	21	24.87	3.87	21.00	11.82	[10-51]	12.44	9.25	16	21.10	5.10	18.00	11.90	[7-53]	12.94	8.88	21	25.29	4.29	23.00	11.79	[8-53]	12.54	9.31
Oxalic Acid use (season)	29	28.28	-0.72	29.00	5.09	[20-47]	5.14	4.11	34	34.75	0.75	34.00	10.10	[18-55]	10.12	8.38	11	15.36	4.36	15.00	6.11	[6-29]	7.50	5.68
SHB Bait Type	58	56.21	-1.79	58.00	7.46	[34-65]	7.67	4.87	21	24.84	3.84	23.00	9.73	[11-48]	10.46	7.72	56	55.97	-0.03	57.00	7.58	[38-68]	7.58	5.91
Oxalic Acid use (PCol)	29	30.47	1.47	30.00	5.12	[22-41]	5.33	4.19	33	34.40	1.40	33.00	10.50	[17-55]	10.59	8.75	45	42.35	-2.65	43.00	10.36	[23-61]	10.70	8.76
Amitraz use (season)	25	28.01	3.01	27.00	5.83	[19-41]	6.56	4.93	47	44.67	-2.33	47.00	11.89	[20-63]	12.12	9.83	5	8.16	3.16	7.00	5.73	[2-23]	6.54	4.03
Fluvalinate use (PCol)	31	32.16	1.16	32.00	7.65	[20-47]	7.74	6.41	24	25.97	1.97	25.00	6.26	[16-40]	6.56	4.99	44	42.63	-1.37	43.00	5.05	[33-53]	5.24	4.16
Tylosin use (PCol)	30	30.57	0.57	31.00	3.45	[24-38]	3.50	2.78	28	30.99	2.99	29.00	11.81	[13-55]	12.18	9.77	32	33.51	1.51	31.00	13.20	[12-60]	13.29	11.02
Coumaphos (Varroa) use (PCol)	24	24.63	0.63	24.00	3.84	[18-33]	3.89	2.98	43	43.26	0.26	43.00	5.25	[33.5-54]	5.26	4.24	43	41.98	-1.02	42.00	6.96	[28.5-55]	7.03	5.67
Coumaphos (SHB) use (PCol)	28	30.09	2.09	30.00	4.09	[23-39]	4.60	3.56	32	32.97	0.97	33.00	3.22	[27-39]	3.36	2.67	38	38.02	0.02	38.00	2.80	[33-43]	2.80	2.23
Drone Removal (PCol)	17	19.51	2.51	17.00	8.60	[10-44]	8.96	6.05	14	18.97	4.97	16.00	11.62	[5-51]	12.64	8.42	29	32.60	3.60	30.00	13.08	[12-59]	13.56	10.87
MiteAThol use (PCol)	41	38.47	-2.53	39.00	5.33	[27-48]	5.90	4.59	37	36.35	-0.65	37.00	6.77	[23-49]	6.80	5.49	46	42.80	-3.20	43.00	8.25	[27-58]	8.84	7.12
Coumaphos (Varroa) use (season)	32	34.38	2.38	34.00	5.77	[24-45]	6.24	5.07	44	44.76	0.76	45.00	5.51	[34-55]	5.56	4.50	41	39.79	-1.21	40.00	6.18	[28-51]	6.30	5.10
Nosema Monitoring Technique	72	70.70	-1.30	71.00	1.47	[67-72]	1.96	1.30	17	24.47	7.47	19.00	17.33	[4-63]	18.87	13.76	64	52.81	-11.19	60.00	19.24	[9-72]	22.26	15.36
MiteAThol use (season)	36	36.53	0.53	37.00	5.94	[25-47]	5.96	4.89	30	31.12	1.12	31.00	7.29	[18-45]	7.38	6.01	48	45.73	-2.27	46.00	7.99	[30-60]	8.30	6.63
Fluvalinate use (season)	38	36.73	-1.27	37.00	7.67	[22-50]	7.77	6.43	42	41.75	-0.25	42.00	8.39	[25-57]	8.40	6.91	37	36.68	-0.32	36.00	6.05	[26-49]	6.06	4.99
Drone Removal Amount	40	37.45	-2.55	39.00	9.91	[19-53]	10.23	8.49	64	60.58	-3.42	62.00	5.74	[46-68]	6.68	4.69	24	27.48	3.48	27.00	6.00	[17-42]	6.93	5.27
Tylosin use (season)	34	36.16	2.16	36.00	3.41	[30-43]	4.04	3.24	56	52.17	-3.83	54.00	9.93	[28-66]	10.64	7.74	65	56.89	-8.11	60.00	11.84	[26-71]	14.35	9.91
Nozevit use (PCol)	42	39.81	-2.19	40.00	4.92	[29-49]	5.38	4.22	45	45.59	0.59	46.00	6.74	[31-57]	6.77	5.48	40	38.67	-1.33	39.00	8.70	[23-55]	8.80	7.35
SHB Soil Drench use (month&PCol)	47	46.24	-0.76	47.00	3.94	[37-53]	4.01	3.02	40	40.64	0.64	41.00	5.69	[30-51]	5.73	4.61	35	34.70	-0.30	35.00	3.16	[28-41]	3.17	2.52
Nozevit use (season)	25	25.98	0.98	26.00	5.12	[16-36]	5.21	4.26	38	38.76	0.76	39.00	9.82	[20-56]	9.85	8.22	47	43.34	-3.66	45.00	10.62	[23-61]	11.24	8.98
Queen Source	51	51.19	0.19	52.00	5.24	[38-59]	5.25	3.88	23	25.96	2.96	23.00	11.54	[10-53]	11.91	9.09	12	17.24	5.24	16.00	7.82	[6-37]	9.42	6.78
Foundation Type	56	52.23	-3.77	56.00	12.34	[17-66]	12.90	8.33	58	51.53	-6.47	55.00	12.19	[22-67]	13.80	9.83	57	55.82	-1.18	57.00	8.64	[34-68]	8.72	6.59
Terramycin use (season)	49	48.72	-0.28	50.00	6.11	[32-57]	6.11	4.48	51	46.52	-4.48	49.00	12.75	[19-65]	13.51	10.48	62	55.85	-6.15	59.00	12.67	[24-71]	14.08	9.96
Nosema Products Applications (count)	37	36.51	-0.49	38.00	9.58	[19-52]	9.60	8.21	55	51.16	-3.84	54.00	11.63	[22-67]	12.25	9.02	10	16.60	6.60	14.00	10.67	[4-47]	12.55	8.45
Sources of Information (count)	26	30.83	4.83	27.00	14.57	[10-56]	15.35	12.77	57	51.25	-5.75	54.00	12.33	[22-67]	13.61	9.76	60	54.78	-5.22	58.00	12.99	[23-70]	14.00	10.03
Fumagilin use (PCol)	27	30.47	3.47	28.00	10.93	[14-51]	11.46	9.36	59	53.11	-5.89	55.00	10.14	[27-67]	11.72	8.31	50	48.51	-1.49	51.00	13.11	[20-67]	13.19	10.57
Terramycin use (PCol)	46	44.94	-1.06	46.00	7.38	[27-55]	7.46	5.60	41	40.16	-0.84	41.00	12.40	[18-61]	12.43	10.55	19	23.41	4.41	20.00	13.25	[5-56]	13.96	10.26
Hop Oil use (PCol)	44	43.80	-0.20	45.00	6.05	[29-53]	6.06	4.69	50	47.47	-2.53	49.00	9.30	[26-62]	9.64	7.43	63	57.73	-5.27	59.00	8.51	[36-70]	10.01	7.26
Equipment Type	63	58.67	-4.33	61.00	9.94	[24-68]	10.84	6.21	62	56.74	-5.26	60.00	10.54	[27.98-69]	11.78	7.95	42	41.34	-0.66	43.00	11.70	[19-61]	11.72	9.91
Thymol use (season)	33	35.06	2.06	36.00	12.08	[15-55]	12.25	10.73	66	63.14	-2.86	65.00	6.56	[46-70]	7.16	4.61	49	44.69	-4.31	48.00	16.61	[13-69]	17.16	14.13
Moved across state lines (Y/N)	52	50.31	-1.69	52.00	7.59	[28-60]	7.78	5.29	54	47.55	-6.45	52.00	15.84	[14-68]	17.11	12.98	54	48.71	-5.29	55.00	19.56	[9-72]	20.27	16.28
Beekeeping Education	54	50.96	-3.04	55.00	12.69	[17-65]	13.05	8.87	52	47.17	-4.83	50.00	14.15	[17-67]	14.95	11.64	68	59.10	-8.90	62.00	10.87	[29-71]	14.05	9.66
SBB (months)	53	46.00	-7.00	52.00	16.13	[11-65]	17.58	12.54	46	43.06	-2.94	47.00	16.74	[11-67]	17.00	14.36	55	52.57	-2.43	55.00	11.51	[25-69]	11.76	9.00
Queens Replaced (Y/N)	13	25.96	12.96	16.00	20.42	[5-65]	24.19	16.79	70	64.37	-5.63	69.00	11.51	[24-72]	12.81	6.30	53	47.65	-5.35	55.00	21.99	[6-72]	22.63	18.74
Years of Beekeeping	19	26.35	7.35	20.00	15.66	[8-58]	17.29	12.80	6	8.77	2.77	6.00	7.99	[2-32]	8.46	4.63	39	38.59	-0.41	38.00	21.73	[4-71]	21.73	19.50
October Brood Chamber Size	59	55.55	-3.45	59.00	10.74	[27-67]	11.28	6.88	48	44.46	-3.54	48.00	16.27	[13-67]	16.69	13.80	66	56.10	-9.90	60.00	13.36	[22-71]	16.63	11.44
Honey Harvest (Y/N)	65	59.54	-5.46	64.00	13.20	[15-71]	14.28	7.96	9	12.23	3.23	9.00	9.47	[3-41]	10.82	6.53	33	36.22	3.22	35.00	18.18	[7-68]	18.46	15.91
Feeding (season)	50	45.10	-4.90	51.00	15.10	[13-63]	15.88	11.79	39	38.85	-0.15	40.00	16.85	[10-66]	16.85	14.78	34	35.73	1.73	33.00	17.22	[9-67]	17.31	14.96
Fumagilin use (season)	48	47.71	-0.29	50.00	8.34	[25-58]	8.34	6.21	67	64.01	-2.99	65.00	5.27	[50-70]	6.06	3.91	51	49.66	-1.34	53.00	13.47	[19-68]	13.53	10.79
Varroa IPM Practices (count)	64	61.38	-2.62	63.00	7.17	[42-69]	7.64	4.44	65	57.90	-7.10	62.00	13.04	[21-71]	14.85	9.35	58	52.03	-5.97	57.00	17.45	[13-72]	18.44	13.85
ReQueening Technique	57	56.30	-0.70	57.00	5.27	[43-63]	5.31	3.62	61	55.14	-5.86	58.00	10.78	[26-68]	12.27	8.42	52	50.97	-1.03	54.00	13.91	[20-70]	13.94	11.13
Nosema Treatment (Y/N)	55	50.07	-4.93	56.00	15.41	[12-67]	16.18	11.11	60	47.97	-12.03	56.00	21.07	[7-71]	24.26	17.71	71	52.95	-18.05	64.00	22.33	[4-72]	28.71	18.45
Started New Cols (Y/N)	66	58.99	-7.01	64.00	14.04	[14-72]	15.69	8.81	27	31.97	4.97	29.00	16.64	[7.98-64]	17.37	14.29	36	37.21	1.21	36.00	19.32	[6-69]	19.36	17.05
Varroa Monitoring Technique	60	57.11	-2.89	61.00	12.53	[17-69]	12.86	7.88	9	14.44	5.44	10.00	12.46	[3-53]	13.60	8.24	2	3.66	1.66	2.00	4.97	[1-17]	5.24	2.37
Feeding Products Type	68	67.45	-0.55	68.00	2.85	[61-71]	2.90	1.94	71	70.05	-0.95	71.00	3.09	[63-72]	3.23	1.32	72	66.94	-5.06	71.00	9.26	[35-72]	10.55	5.06
Varroa Products Applications (count)	62	60.02	-1.98	61.00	6.10	[45-67]	6.42	3.95	3	5.71	2.71	5.00	4.00	[2-16]	4.83	2.91	8	16.41	8.41	12.00	13.80	[3-65]	16.16	10.36
Varroa Monitoring (Freq)	70	70.10	0.10	70.00	1.53	[67-72]	1.53	1.20	69	66.77	-2.23	68.00	4.86	[54-72]	5.35	3.08	67	56.94	-10.06	61.00	12.53	[24-71]	16.07	11.06
Brood Inspection (Freq)	67	64.93	-2.07	65.00	3.03	[57-69]	3.67	2.59	53	48.31	-4.69	51.00	12.83	[20-66]	13.66	10.35	70	60.31	-9.69	63.00	9.95	[31-71]	13.88	9.84
Nosema Monitoring (Freq)	61	58.41	-2.59	61.00	9.96	[24.98-68]	10.29	6.22	26	32.18	6.18	28.00	19.22	[6-67]	20.19	16.74	17	22.31	5.31	17.00	16.69	[3-63]	17.52	12.85
Average Queen Age	69	67.77	-1.23	68.00	3.45	[59-72]	3.66	2.41	68	62.51	-5.49	66.00	9.57	[31-71]	11.03	6.33	30	34.12	4.12	31.00	17.52	[7-66]	18.00	15.09
Feeding (Y/N)	71	70.15	-0.85	70.00	1.73	[66-72]	1.92	1.35	72	71.33	-0.67	72.00	1.43	[68-72]	1.58	0.67	61	53.74	-7.27	59.00	15.84	[15-71]	17.43	12.31

Original Ranking (Or.Rank) from most sensitive (1) to least sensitive (72) based on change in correlation value (Pearson's) of the simplified index with standardized Winter Loss on the original sample (before bootstrapping); b.mean = average estimated value (rank) from the bootstrap; b.bias = bootstrap bias; b.median = median estimated value from the bootstrap; b.sd = bootstrap standard error; Perc CI = Percentile confidence interval for α=0.05; RootMSE = root mean squared error; MAE= mean absolute error.

Appendix 9. <u>*Index performance by increasing number of component criteria in the index, based on sensitivity ranking.*</u>

Pearson's correlation to Standardized Winter Loss; Imputation method “mean”; no weight. Star (*) indicates criteria retained in Optimized Management Index

N Criteria in index		Criteria in index (up to)	Subset	Pearson Corr	95% CI	t.stat	df	p value
		Subset = All, N=18,981						
Top 1	*	Action on Deadouts	All	-0.077	[-0.09,-0.06]	-9.219	14276	<0.001
Top 2	*	New Colonies Technique	All	-0.173	[-0.19,-0.16]	-24.245	18969	<0.001
Top 3	*	Varroa Treatment (Y/N)	All	-0.221	[-0.23,-0.21]	-31.162	18969	<0.001
Top 4	*	Comb Culling and Storage Technique	All	-0.255	[-0.27,-0.24]	-36.378	18969	<0.001
Top 5	*	Winter Preparation Technique	All	-0.261	[-0.27,-0.25]	-37.183	18969	<0.001
Top 6	*	Crops (count)	All	-0.257	[-0.27,-0.24]	-36.687	18969	<0.001
Top 7	*	Varroa Products Type (count)	All	-0.260	[-0.27,-0.25]	-37.052	18969	<0.001
Top 8	*	Powder Sugar use (months)	All	-0.266	[-0.28,-0.25]	-38.075	18969	<0.001
Top 9	*	Thymol use (count)	All	-0.261	[-0.27,-0.25]	-37.307	18969	<0.001
Top 10	*	Honey Produced (lbs)	All	-0.258	[-0.27,-0.25]	-36.838	18969	<0.001
Top 11	*	Formic Acid use (season)	All	-0.262	[-0.27,-0.25]	-37.342	18969	<0.001
Top 12	*	Average Comb Age	All	-0.260	[-0.27,-0.25]	-37.066	18969	<0.001
Top 13	*	Formic Acid use (PCol)	All	-0.262	[-0.27,-0.25]	-37.322	18969	<0.001
Top 14	*	SHB Control Technique	All	-0.262	[-0.28,-0.25]	-37.378	18969	<0.001
Top 15	*	Thymol use (PCol)	All	-0.260	[-0.27,-0.25]	-37.102	18969	<0.001
Top 16	*	SHB Trap use (month)	All	-0.260	[-0.27,-0.25]	-37.124	18969	<0.001
Top 17	*	SBB (PCol)	All	-0.266	[-0.28,-0.25]	-38.029	18969	<0.001
Top 18	*	Queens Replaced (PCol)	All	-0.266	[-0.28,-0.25]	-38.010	18969	<0.001
Top 19	*	Amitraz use (PCol)	All	-0.268	[-0.28,-0.25]	-38.311	18969	<0.001
Top 20	*	Amitraz use (count)	All	-0.269	[-0.28,-0.26]	-38.472	18969	<0.001
Top 21	*	States (count)	All	-0.270	[-0.28,-0.26]	-38.581	18969	<0.001
Top 22		Drone Removal (Freq)	All	-0.269	[-0.28,-0.26]	-38.409	18969	<0.001
Top 23		Oxalic Acid use (season)	All	-0.269	[-0.28,-0.26]	-38.500	18969	<0.001
Top 24		SHB Bait Type	All	-0.267	[-0.28,-0.25]	-38.123	18969	<0.001
Top 25		Oxalic Acid use (PCol)	All	-0.267	[-0.28,-0.25]	-38.176	18969	<0.001
Top 26		Amitraz use (season)	All	-0.267	[-0.28,-0.25]	-38.213	18969	<0.001
Top 27		Fluvalinate use (PCol)	All	-0.268	[-0.28,-0.25]	-38.240	18969	<0.001
Top 28		Tylosin use (PCol)	All	-0.268	[-0.28,-0.25]	-38.256	18969	<0.001
Top 29		Coumaphos (Varroa) use (PCol)	All	-0.268	[-0.28,-0.25]	-38.260	18969	<0.001
Top 30		Coumaphos (SHB) use (PCol)	All	-0.268	[-0.28,-0.25]	-38.261	18969	<0.001
Top 31		Drone Removal (PCol)	All	-0.266	[-0.28,-0.25]	-38.044	18969	<0.001
Top 32		MiteAThol use (PCol)	All	-0.266	[-0.28,-0.25]	-38.029	18969	<0.001

Top 33		Coumaphos (Varroa) use (season)	All	-0.266	[-0.28,-0.25]	-37.993	18969	<0.001
Top 34		Nosema Monitoring Technique	All	-0.265	[-0.28,-0.25]	-37.806	18969	<0.001
Top 35		MiteAThol use (season)	All	-0.264	[-0.28,-0.25]	-37.737	18969	<0.001
Top 36		Fluvalinate use (season)	All	-0.264	[-0.28,-0.25]	-37.653	18969	<0.001
Top 37		Drone Removal Amount	All	-0.264	[-0.28,-0.25]	-37.621	18969	<0.001
Top 38		Tylosin use (season)	All	-0.263	[-0.28,-0.25]	-37.550	18969	<0.001
Top 39		Nozevit use (PCol)	All	-0.263	[-0.28,-0.25]	-37.482	18969	<0.001
Top 40		SHB Soil Drench use (month&PCol)	All	-0.262	[-0.28,-0.25]	-37.428	18969	<0.001
Top 41		Nozevit use (season)	All	-0.262	[-0.27,-0.25]	-37.342	18969	<0.001
Top 42		Queen Source	All	-0.261	[-0.27,-0.25]	-37.218	18969	<0.001
Top 43		Foundation Type	All	-0.257	[-0.27,-0.24]	-36.682	18969	<0.001
Top 44		Terramycin use (season)	All	-0.256	[-0.27,-0.24]	-36.512	18969	<0.001
Top 45		Nosema Products Applications (count)	All	-0.255	[-0.27,-0.24]	-36.388	18969	<0.001
Top 46		Sources of Information (count)	All	-0.253	[-0.27,-0.24]	-36.055	18969	<0.001
Top 47		Fumagilin use (PCol)	All	-0.252	[-0.27,-0.24]	-35.866	18969	<0.001
Top 48		Terramycin use (PCol)	All	-0.250	[-0.26,-0.24]	-35.582	18969	<0.001
Top 49		Hop Oil use (PCol)	All	-0.248	[-0.26,-0.24]	-35.333	18969	<0.001
Top 50		Equipment Type	All	-0.247	[-0.26,-0.23]	-35.168	18969	<0.001
Top 51		Thymol use (season)	All	-0.245	[-0.26,-0.23]	-34.740	18969	<0.001
Top 52		Moved across state lines (Y/N)	All	-0.246	[-0.26,-0.23]	-34.993	18969	<0.001
Top 53		Beekeeping Education	All	-0.241	[-0.25,-0.23]	-34.265	18969	<0.001
Top 54		SBB (months)	All	-0.237	[-0.25,-0.22]	-33.606	18969	<0.001
Top 55		Queens Replaced (Y/N)	All	-0.228	[-0.24,-0.21]	-32.268	18969	<0.001
Top 56		Years of Beekeeping	All	-0.224	[-0.24,-0.21]	-31.696	18969	<0.001
Top 57		October Brood Chamber Size	All	-0.221	[-0.23,-0.21]	-31.146	18969	<0.001
Top 58		Honey Harvest (Y/N)	All	-0.213	[-0.23,-0.2]	-30.062	18969	<0.001
Top 59		Feeding (season)	All	-0.213	[-0.23,-0.2]	-30.006	18969	<0.001
Top 60		Fumagilin use (season)	All	-0.211	[-0.22,-0.2]	-29.726	18969	<0.001
Top 61		Varroa IPM Practices (count)	All	-0.207	[-0.22,-0.19]	-29.155	18969	<0.001
Top 62		ReQueening Technique	All	-0.205	[-0.22,-0.19]	-28.816	18969	<0.001
Top 63		Nosema Treatment (Y/N)	All	-0.197	[-0.21,-0.18]	-27.612	18969	<0.001
Top 64		Started New Cols (Y/N)	All	-0.193	[-0.21,-0.18]	-27.081	18969	<0.001
Top 65		Varroa Monitoring Technique	All	-0.188	[-0.2,-0.17]	-26.364	18969	<0.001
Top 66		Feeding Products Type	All	-0.184	[-0.2,-0.17]	-25.775	18969	<0.001
Top 67		Varroa Products Applications (count)	All	-0.180	[-0.19,-0.17]	-25.229	18969	<0.001
Top 68		Varroa Monitoring (Freq)	All	-0.176	[-0.19,-0.16]	-24.554	18969	<0.001
Top 69		Brood Inspection (Freq)	All	-0.171	[-0.18,-0.16]	-23.842	18969	<0.001
Top 70		Nosema Monitoring (Freq)	All	-0.165	[-0.18,-0.15]	-22.979	18969	<0.001
Top 71		Average Queen Age	All	-0.159	[-0.17,-0.15]	-22.187	18969	<0.001
Top 72		Feeding (Y/N)	All	-0.154	[-0.17,-0.14]	-21.408	18969	<0.001
Subset = S.No., N=11,630								
Top 1	*	Action on Deadouts	S.No.	-0.066	[-0.09,-0.05]	-6.240	8803	<0.001

Top 2	*	Varroa Treatment (Y/N)	S.No.	-0.225	[-0.24,-0.21]	-24.944	11628	<0.001
Top 3	*	New Colonies Technique	S.No.	-0.239	[-0.26,-0.22]	-26.557	11628	<0.001
Top 4	*	Comb Culling and Storage Technique	S.No.	-0.266	[-0.28,-0.25]	-29.712	11628	<0.001
Top 5	*	Formic Acid use (season)	S.No.	-0.268	[-0.29,-0.25]	-30.056	11628	<0.001
Top 6	*	Varroa Products Type (count)	S.No.	-0.273	[-0.29,-0.26]	-30.657	11628	<0.001
Top 7	*	Powder Sugar use (months)	S.No.	-0.280	[-0.3,-0.26]	-31.455	11628	<0.001
Top 8	*	Thymol use (count)	S.No.	-0.275	[-0.29,-0.26]	-30.891	11628	<0.001
Top 9	*	Crops (count)	S.No.	-0.273	[-0.29,-0.26]	-30.619	11628	<0.001
Top 10	*	Formic Acid use (PCol)	S.No.	-0.276	[-0.29,-0.26]	-30.908	11628	<0.001
Top 11	*	Nosema Monitoring Technique	S.No.	-0.274	[-0.29,-0.26]	-30.742	11628	<0.001
Top 12	*	October Brood Chamber Size	S.No.	-0.280	[-0.3,-0.26]	-31.447	11628	<0.001
Top 13	*	SBB (PCol)	S.No.	-0.285	[-0.3,-0.27]	-32.008	11628	<0.001
Top 14	*	Thymol use (PCol)	S.No.	-0.282	[-0.3,-0.27]	-31.754	11628	<0.001
Top 15	*	Queens Replaced (PCol)	S.No.	-0.282	[-0.3,-0.27]	-31.745	11628	<0.001
Top 16	*	Average Comb Age	S.No.	-0.285	[-0.3,-0.27]	-32.057	11628	<0.001
Top 17		SBB (months)	S.No.	-0.279	[-0.3,-0.26]	-31.334	11628	<0.001
Top 18		Equipment Type	S.No.	-0.277	[-0.29,-0.26]	-31.072	11628	<0.001
Top 19		Oxalic Acid use (season)	S.No.	-0.278	[-0.29,-0.26]	-31.224	11628	<0.001
Top 20		Oxalic Acid use (PCol)	S.No.	-0.279	[-0.3,-0.26]	-31.328	11628	<0.001
Top 21		Amitraz use (count)	S.No.	-0.280	[-0.3,-0.26]	-31.510	11628	<0.001
Top 22		Moved across state lines (Y/N)	S.No.	-0.281	[-0.3,-0.26]	-31.631	11628	<0.001
Top 23		Honey Produced (lbs)	S.No.	-0.279	[-0.3,-0.26]	-31.298	11628	<0.001
Top 24		Amitraz use (PCol)	S.No.	-0.280	[-0.3,-0.26]	-31.404	11628	<0.001
Top 25		Foundation Type	S.No.	-0.275	[-0.29,-0.26]	-30.824	11628	<0.001
Top 26		Fluvalinate use (PCol)	S.No.	-0.275	[-0.29,-0.26]	-30.843	11628	<0.001
Top 27		Drone Removal Amount	S.No.	-0.274	[-0.29,-0.26]	-30.782	11628	<0.001
Top 28		MiteAThol use (PCol)	S.No.	-0.275	[-0.29,-0.26]	-30.810	11628	<0.001
Top 29		States (count)	S.No.	-0.275	[-0.29,-0.26]	-30.895	11628	<0.001
Top 30		SHB Trap use (month)	S.No.	-0.275	[-0.29,-0.26]	-30.794	11628	<0.001
Top 31		Drone Removal (Freq)	S.No.	-0.272	[-0.29,-0.26]	-30.514	11628	<0.001
Top 32		SHB Soil Drench use (month&PCol)	S.No.	-0.272	[-0.29,-0.26]	-30.511	11628	<0.001
Top 33		Coumaphos (SHB) use (PCol)	S.No.	-0.272	[-0.29,-0.26]	-30.511	11628	<0.001
Top 34		Varroa IPM Practices (count)	S.No.	-0.269	[-0.29,-0.25]	-30.089	11628	<0.001
Top 35		Coumaphos (Varroa) use (season)	S.No.	-0.269	[-0.29,-0.25]	-30.076	11628	<0.001
Top 36		Coumaphos (Varroa) use (PCol)	S.No.	-0.269	[-0.29,-0.25]	-30.057	11628	<0.001
Top 37		Amitraz use (season)	S.No.	-0.268	[-0.29,-0.25]	-30.045	11628	<0.001
Top 38		Terramycin use (season)	S.No.	-0.268	[-0.29,-0.25]	-30.045	11628	<0.001
Top 39		Tylosin use (PCol)	S.No.	-0.268	[-0.29,-0.25]	-30.039	11628	<0.001
Top 40		MiteAThol use (season)	S.No.	-0.268	[-0.28,-0.25]	-30.017	11628	<0.001
Top 41		Nozevit use (PCol)	S.No.	-0.268	[-0.28,-0.25]	-30.001	11628	<0.001
Top 42		Fluvalinate use (season)	S.No.	-0.268	[-0.28,-0.25]	-29.963	11628	<0.001
Top 43		Tylosin use (season)	S.No.	-0.267	[-0.28,-0.25]	-29.928	11628	<0.001

Top 44		Drone Removal (PCol)	S.No.	-0.265	[-0.28,-0.25]	-29.665	11628	<0.001
Top 45		Winter Preparation Technique	S.No.	-0.266	[-0.28,-0.25]	-29.800	11628	<0.001
Top 46		Fumagilin use (PCol)	S.No.	-0.266	[-0.28,-0.25]	-29.734	11628	<0.001
Top 47		Nozevit use (season)	S.No.	-0.265	[-0.28,-0.25]	-29.690	11628	<0.001
Top 48		SHB Bait Type	S.No.	-0.265	[-0.28,-0.25]	-29.651	11628	<0.001
Top 49		Queen Source	S.No.	-0.265	[-0.28,-0.25]	-29.658	11628	<0.001
Top 50		Sources of Information (count)	S.No.	-0.264	[-0.28,-0.25]	-29.549	11628	<0.001
Top 51		Nosema Products Applications (count)	S.No.	-0.263	[-0.28,-0.25]	-29.428	11628	<0.001
Top 52		Hop Oil use (PCol)	S.No.	-0.262	[-0.28,-0.25]	-29.278	11628	<0.001
Top 53		Terramycin use (PCol)	S.No.	-0.261	[-0.28,-0.24]	-29.101	11628	<0.001
Top 54		Honey Harvest (Y/N)	S.No.	-0.253	[-0.27,-0.24]	-28.169	11628	<0.001
Top 55		Fumagilin use (season)	S.No.	-0.251	[-0.27,-0.23]	-27.973	11628	<0.001
Top 56		Beekeeping Education	S.No.	-0.248	[-0.26,-0.23]	-27.595	11628	<0.001
Top 57		Nosema Treatment (Y/N)	S.No.	-0.238	[-0.25,-0.22]	-26.401	11628	<0.001
Top 58		Thymol use (season)	S.No.	-0.235	[-0.25,-0.22]	-26.091	11628	<0.001
Top 59		Years of Beekeeping	S.No.	-0.231	[-0.25,-0.21]	-25.611	11628	<0.001
Top 60		Feeding Products Type	S.No.	-0.230	[-0.25,-0.21]	-25.489	11628	<0.001
Top 61		ReQueening Technique	S.No.	-0.226	[-0.24,-0.21]	-25.017	11628	<0.001
Top 62		Varroa Monitoring (Freq)	S.No.	-0.222	[-0.24,-0.2]	-24.554	11628	<0.001
Top 63		Started New Cols (Y/N)	S.No.	-0.219	[-0.24,-0.2]	-24.219	11628	<0.001
Top 64		SHB Control Technique	S.No.	-0.215	[-0.23,-0.2]	-23.710	11628	<0.001
Top 65		Queens Replaced (Y/N)	S.No.	-0.210	[-0.23,-0.19]	-23.133	11628	<0.001
Top 66		Varroa Monitoring Technique	S.No.	-0.205	[-0.22,-0.19]	-22.582	11628	<0.001
Top 67		Feeding (Y/N)	S.No.	-0.201	[-0.22,-0.18]	-22.162	11628	<0.001
Top 68		Brood Inspection (Freq)	S.No.	-0.197	[-0.21,-0.18]	-21.632	11628	<0.001
Top 69		Average Queen Age	S.No.	-0.191	[-0.21,-0.17]	-20.984	11628	<0.001
Top 70		Feeding (season)	S.No.	-0.185	[-0.2,-0.17]	-20.246	11628	<0.001
Top 71		Varroa Products Applications (count)	S.No.	-0.178	[-0.2,-0.16]	-19.480	11628	<0.001
Top 72		Nosema Monitoring (Freq)	S.No.	-0.171	[-0.19,-0.15]	-18.724	11628	<0.001
Subset = S.So., N=6,411								
Top 1	*	Action on Deadouts	S.So.	-0.071	[-0.1,-0.04]	-4.813	4558	<0.001
Top 2	*	New Colonies Technique	S.So.	-0.167	[-0.19,-0.14]	-13.540	6409	<0.001
Top 3	*	Varroa Treatment (Y/N)	S.So.	-0.181	[-0.21,-0.16]	-14.775	6409	<0.001
Top 4	*	Honey Produced (lbs)	S.So.	-0.189	[-0.21,-0.16]	-15.383	6409	<0.001
Top 5	*	Comb Culling and Storage Technique	S.So.	-0.224	[-0.25,-0.2]	-18.428	6409	<0.001
Top 6	*	Crops (count)	S.So.	-0.222	[-0.25,-0.2]	-18.263	6409	<0.001
Top 7	*	SHB Trap use (month)	S.So.	-0.224	[-0.25,-0.2]	-18.394	6409	<0.001
Top 8	*	Varroa Products Type (count)	S.So.	-0.224	[-0.25,-0.2]	-18.385	6409	<0.001
Top 9	*	Average Comb Age	S.So.	-0.231	[-0.25,-0.21]	-19.001	6409	<0.001
Top 10		SHB Control Technique	S.So.	-0.226	[-0.25,-0.2]	-18.547	6409	<0.001
Top 11		Thymol use (count)	S.So.	-0.222	[-0.25,-0.2]	-18.263	6409	<0.001

Top 12	Winter Preparation Technique	S.So.	-0.227	[-0.25,-0.2]	-18.629	6409	<0.001
Top 13	Queens Replaced (Y/N)	S.So.	-0.205	[-0.23,-0.18]	-16.745	6409	<0.001
Top 14	Amitraz use (count)	S.So.	-0.206	[-0.23,-0.18]	-16.877	6409	<0.001
Top 15	Formic Acid use (season)	S.So.	-0.207	[-0.23,-0.18]	-16.970	6409	<0.001
Top 16	Thymol use (PCol)	S.So.	-0.207	[-0.23,-0.18]	-16.940	6409	<0.001
Top 17	Drone Removal (PCol)	S.So.	-0.208	[-0.23,-0.18]	-17.054	6409	<0.001
Top 18	Formic Acid use (PCol)	S.So.	-0.209	[-0.23,-0.19]	-17.125	6409	<0.001
Top 19	Years of Beekeeping	S.So.	-0.206	[-0.23,-0.18]	-16.841	6409	<0.001
Top 20	States (count)	S.So.	-0.207	[-0.23,-0.18]	-16.902	6409	<0.001
Top 21	Drone Removal (Freq)	S.So.	-0.206	[-0.23,-0.18]	-16.892	6409	<0.001
Top 22	Powder Sugar use (months)	S.So.	-0.208	[-0.23,-0.18]	-17.011	6409	<0.001
Top 23	Amitraz use (PCol)	S.So.	-0.208	[-0.23,-0.18]	-17.041	6409	<0.001
Top 24	Coumaphos (Varroa) use (PCol)	S.So.	-0.209	[-0.23,-0.19]	-17.090	6409	<0.001
Top 25	Amitraz use (season)	S.So.	-0.209	[-0.23,-0.19]	-17.108	6409	<0.001
Top 26	Sources of Information (count)	S.So.	-0.207	[-0.23,-0.18]	-16.915	6409	<0.001
Top 27	Fumagilin use (PCol)	S.So.	-0.207	[-0.23,-0.18]	-16.964	6409	<0.001
Top 28	Coumaphos (SHB) use (PCol)	S.So.	-0.207	[-0.23,-0.18]	-16.970	6409	<0.001
Top 29	Oxalic Acid use (PCol)	S.So.	-0.207	[-0.23,-0.18]	-16.973	6409	<0.001
Top 30	Tylosin use (PCol)	S.So.	-0.208	[-0.23,-0.18]	-16.983	6409	<0.001
Top 31	Fluvalinate use (PCol)	S.So.	-0.207	[-0.23,-0.18]	-16.965	6409	<0.001
Top 32	Coumaphos (Varroa) use (season)	S.So.	-0.207	[-0.23,-0.18]	-16.951	6409	<0.001
Top 33	Thymol use (season)	S.So.	-0.206	[-0.23,-0.18]	-16.830	6409	<0.001
Top 34	Tylosin use (season)	S.So.	-0.206	[-0.23,-0.18]	-16.815	6409	<0.001
Top 35	Nozevit use (season)	S.So.	-0.205	[-0.23,-0.18]	-16.788	6409	<0.001
Top 36	MiteAThol use (season)	S.So.	-0.205	[-0.23,-0.18]	-16.760	6409	<0.001
Top 37	Nosema Products Applications (count)	S.So.	-0.204	[-0.23,-0.18]	-16.701	6409	<0.001
Top 38	Fluvalinate use (season)	S.So.	-0.204	[-0.23,-0.18]	-16.660	6409	<0.001
Top 39	Oxalic Acid use (season)	S.So.	-0.203	[-0.23,-0.18]	-16.634	6409	<0.001
Top 40	Drone Removal Amount	S.So.	-0.203	[-0.23,-0.18]	-16.582	6409	<0.001
Top 41	MiteAThol use (PCol)	S.So.	-0.202	[-0.23,-0.18]	-16.546	6409	<0.001
Top 42	Nozevit use (PCol)	S.So.	-0.202	[-0.23,-0.18]	-16.511	6409	<0.001
Top 43	SBB (PCol)	S.So.	-0.204	[-0.23,-0.18]	-16.697	6409	<0.001
Top 44	Hop Oil use (PCol)	S.So.	-0.203	[-0.23,-0.18]	-16.625	6409	<0.001
Top 45	Queens Replaced (PCol)	S.So.	-0.202	[-0.23,-0.18]	-16.543	6409	<0.001
Top 46	Terramycin use (PCol)	S.So.	-0.201	[-0.22,-0.18]	-16.442	6409	<0.001
Top 47	SHB Soil Drench use (month&PCol)	S.So.	-0.200	[-0.22,-0.18]	-16.368	6409	<0.001
Top 48	Fumagilin use (season)	S.So.	-0.199	[-0.22,-0.17]	-16.222	6409	<0.001
Top 49	Terramycin use (season)	S.So.	-0.197	[-0.22,-0.17]	-16.094	6409	<0.001
Top 50	Feeding (season)	S.So.	-0.199	[-0.22,-0.17]	-16.222	6409	<0.001
Top 51	Queen Source	S.So.	-0.196	[-0.22,-0.17]	-15.998	6409	<0.001
Top 52	Moved across state lines (Y/N)	S.So.	-0.201	[-0.22,-0.18]	-16.426	6409	<0.001
Top 53	SBB (months)	S.So.	-0.200	[-0.22,-0.18]	-16.303	6409	<0.001

Top 54		Beekeeping Education	S.So.	-0.194	[-0.22,-0.17]	-15.856	6409	<0.001
Top 55		Nosema Treatment (Y/N)	S.So.	-0.181	[-0.2,-0.16]	-14.712	6409	<0.001
Top 56		Foundation Type	S.So.	-0.177	[-0.2,-0.15]	-14.378	6409	<0.001
Top 57		ReQueening Technique	S.So.	-0.175	[-0.2,-0.15]	-14.228	6409	<0.001
Top 58		SHB Bait Type	S.So.	-0.171	[-0.19,-0.15]	-13.905	6409	<0.001
Top 59		October Brood Chamber Size	S.So.	-0.168	[-0.19,-0.14]	-13.664	6409	<0.001
Top 60		Varroa Monitoring Technique	S.So.	-0.159	[-0.18,-0.14]	-12.919	6409	<0.001
Top 61		Nosema Monitoring (Freq)	S.So.	-0.151	[-0.18,-0.13]	-12.253	6409	<0.001
Top 62		Varroa Products Applications (count)	S.So.	-0.150	[-0.17,-0.13]	-12.112	6409	<0.001
Top 63		Equipment Type	S.So.	-0.147	[-0.17,-0.12]	-11.893	6409	<0.001
Top 64		Varroa IPM Practices (count)	S.So.	-0.142	[-0.17,-0.12]	-11.465	6409	<0.001
Top 65		Honey Harvest (Y/N)	S.So.	-0.137	[-0.16,-0.11]	-11.060	6409	<0.001
Top 66		Started New Cols (Y/N)	S.So.	-0.133	[-0.16,-0.11]	-10.750	6409	<0.001
Top 67		Brood Inspection (Freq)	S.So.	-0.128	[-0.15,-0.1]	-10.368	6409	<0.001
Top 68		Feeding Products Type	S.So.	-0.123	[-0.15,-0.1]	-9.933	6409	<0.001
Top 69		Average Queen Age	S.So.	-0.117	[-0.14,-0.09]	-9.458	6409	<0.001
Top 70		Varroa Monitoring (Freq)	S.So.	-0.111	[-0.13,-0.09]	-8.915	6409	<0.001
Top 71		Feeding (Y/N)	S.So.	-0.104	[-0.13,-0.08]	-8.394	6409	<0.001
Top 72		Nosema Monitoring Technique	S.So.	-0.097	[-0.12,-0.07]	-7.835	6409	<0.001
Subset = Pr.S., N=596								
Top 1	*	New Colonies Technique	Pr.S.	-0.265	[-0.34,-0.19]	-6.709	594	<0.001
Top 2	*	Honey Produced (lbs)	Pr.S.	-0.308	[-0.38,-0.23]	-7.883	594	<0.001
Top 3	*	Varroa Products Applications (count)	Pr.S.	-0.331	[-0.4,-0.26]	-8.554	594	<0.001
Top 4	*	Varroa Products Type (count)	Pr.S.	-0.326	[-0.4,-0.25]	-8.411	594	<0.001
Top 5	*	Varroa Treatment (Y/N)	Pr.S.	-0.352	[-0.42,-0.28]	-9.156	594	<0.001
Top 6	*	Years of Beekeeping	Pr.S.	-0.344	[-0.41,-0.27]	-8.943	594	<0.001
Top 7	*	Honey Harvest (Y/N)	Pr.S.	-0.351	[-0.42,-0.28]	-9.150	594	<0.001
Top 8	*	Amitraz use (PCol)	Pr.S.	-0.362	[-0.43,-0.29]	-9.476	594	<0.001
Top 9	*	Varroa Monitoring Technique	Pr.S.	-0.355	[-0.42,-0.28]	-9.259	594	<0.001
Top 10	*	Winter Preparation Technique	Pr.S.	-0.364	[-0.43,-0.29]	-9.534	594	<0.001
Top 11	*	SBB (PCol)	Pr.S.	-0.368	[-0.44,-0.3]	-9.655	594	<0.001
Top 12	*	SHB Trap use (month)	Pr.S.	-0.376	[-0.44,-0.31]	-9.898	594	<0.001
Top 13	*	SHB Control Technique	Pr.S.	-0.377	[-0.44,-0.31]	-9.933	594	<0.001
Top 14	*	Drone Removal (PCol)	Pr.S.	-0.379	[-0.45,-0.31]	-9.989	594	<0.001
Top 15	*	Crops (count)	Pr.S.	-0.384	[-0.45,-0.31]	-10.126	594	<0.001
Top 16		Drone Removal (Freq)	Pr.S.	-0.380	[-0.45,-0.31]	-10.002	594	<0.001
Top 17		Nosema Monitoring Technique	Pr.S.	-0.372	[-0.44,-0.3]	-9.762	594	<0.001
Top 18		Comb Culling and Storage Technique	Pr.S.	-0.369	[-0.44,-0.3]	-9.668	594	<0.001
Top 19		Formic Acid use (PCol)	Pr.S.	-0.370	[-0.44,-0.3]	-9.721	594	<0.001
Top 20		Thymol use (PCol)	Pr.S.	-0.372	[-0.44,-0.3]	-9.767	594	<0.001
Top 21		SHB Bait Type	Pr.S.	-0.371	[-0.44,-0.3]	-9.737	594	<0.001

Top 22	Powder Sugar use (months)	Pr.S.	-0.373	[-0.44,-0.3]	-9.783	594	<0.001
Top 23	Queen Source	Pr.S.	-0.375	[-0.44,-0.3]	-9.868	594	<0.001
Top 24	Fluvalinate use (PCol)	Pr.S.	-0.377	[-0.44,-0.31]	-9.930	594	<0.001
Top 25	Queens Replaced (PCol)	Pr.S.	-0.371	[-0.44,-0.3]	-9.748	594	<0.001
Top 26	Nosema Monitoring (Freq)	Pr.S.	-0.364	[-0.43,-0.29]	-9.526	594	<0.001
Top 27	Started New Cols (Y/N)	Pr.S.	-0.368	[-0.44,-0.3]	-9.639	594	<0.001
Top 28	Tylosin use (PCol)	Pr.S.	-0.367	[-0.43,-0.3]	-9.609	594	<0.001
Top 29	Thymol use (count)	Pr.S.	-0.363	[-0.43,-0.29]	-9.495	594	<0.001
Top 30	MiteAThol use (season)	Pr.S.	-0.363	[-0.43,-0.29]	-9.497	594	<0.001
Top 31	States (count)	Pr.S.	-0.364	[-0.43,-0.29]	-9.519	594	<0.001
Top 32	Coumaphos (SHB) use (PCol)	Pr.S.	-0.364	[-0.43,-0.29]	-9.537	594	<0.001
Top 33	Oxalic Acid use (PCol)	Pr.S.	-0.362	[-0.43,-0.29]	-9.478	594	<0.001
Top 34	Oxalic Acid use (season)	Pr.S.	-0.360	[-0.43,-0.29]	-9.410	594	<0.001
Top 35	Formic Acid use (season)	Pr.S.	-0.358	[-0.43,-0.29]	-9.331	594	<0.001
Top 36	Amitraz use (count)	Pr.S.	-0.357	[-0.43,-0.29]	-9.327	594	<0.001
Top 37	MiteAThol use (PCol)	Pr.S.	-0.357	[-0.42,-0.28]	-9.303	594	<0.001
Top 38	Nozevit use (season)	Pr.S.	-0.356	[-0.42,-0.28]	-9.270	594	<0.001
Top 39	Feeding (season)	Pr.S.	-0.351	[-0.42,-0.28]	-9.123	594	<0.001
Top 40	SHB Soil Drench use (month&PCol)	Pr.S.	-0.349	[-0.42,-0.28]	-9.082	594	<0.001
Top 41	Terramycin use (PCol)	Pr.S.	-0.343	[-0.41,-0.27]	-8.901	594	<0.001
Top 42	Fluvalinate use (season)	Pr.S.	-0.341	[-0.41,-0.27]	-8.838	594	<0.001
Top 43	Coumaphos (Varroa) use (PCol)	Pr.S.	-0.339	[-0.41,-0.27]	-8.782	594	<0.001
Top 44	Coumaphos (Varroa) use (season)	Pr.S.	-0.337	[-0.41,-0.26]	-8.729	594	<0.001
Top 45	Nozevit use (PCol)	Pr.S.	-0.334	[-0.4,-0.26]	-8.644	594	<0.001
Top 46	SBB (months)	Pr.S.	-0.331	[-0.4,-0.26]	-8.554	594	<0.001
Top 47	Amitraz use (season)	Pr.S.	-0.327	[-0.4,-0.25]	-8.438	594	<0.001
Top 48	Action on Deadouts	Pr.S.	-0.317	[-0.39,-0.24]	-8.142	594	<0.001
Top 49	October Brood Chamber Size	Pr.S.	-0.316	[-0.39,-0.24]	-8.109	594	<0.001
Top 50	Hop Oil use (PCol)	Pr.S.	-0.312	[-0.38,-0.24]	-8.016	594	<0.001
Top 51	Terramycin use (season)	Pr.S.	-0.306	[-0.38,-0.23]	-7.824	594	<0.001
Top 52	Beekeeping Education	Pr.S.	-0.302	[-0.37,-0.23]	-7.708	594	<0.001
Top 53	Brood Inspection (Freq)	Pr.S.	-0.298	[-0.37,-0.22]	-7.603	594	<0.001
Top 54	Moved across state lines (Y/N)	Pr.S.	-0.295	[-0.37,-0.22]	-7.518	594	<0.001
Top 55	Nosema Products Applications (count)	Pr.S.	-0.290	[-0.36,-0.21]	-7.384	594	<0.001
Top 56	Tylosin use (season)	Pr.S.	-0.286	[-0.36,-0.21]	-7.266	594	<0.001
Top 57	Sources of Information (count)	Pr.S.	-0.279	[-0.35,-0.2]	-7.082	594	<0.001
Top 58	Foundation Type	Pr.S.	-0.274	[-0.35,-0.2]	-6.934	594	<0.001
Top 59	Fumagilin use (PCol)	Pr.S.	-0.267	[-0.34,-0.19]	-6.756	594	<0.001
Top 60	Nosema Treatment (Y/N)	Pr.S.	-0.253	[-0.33,-0.18]	-6.369	594	<0.001
Top 61	ReQueening Technique	Pr.S.	-0.247	[-0.32,-0.17]	-6.203	594	<0.001
Top 62	Equipment Type	Pr.S.	-0.240	[-0.31,-0.16]	-6.036	594	<0.001
Top 63	Average Comb Age	Pr.S.	-0.235	[-0.31,-0.16]	-5.892	594	<0.001

Top 64		Drone Removal Amount	Pr.S.	-0.228	[-0.3,-0.15]	-5.716	594	<0.001
Top 65		Varroa IPM Practices (count)	Pr.S.	-0.218	[-0.29,-0.14]	-5.457	594	<0.001
Top 66		Thymol use (season)	Pr.S.	-0.210	[-0.29,-0.13]	-5.239	594	<0.001
Top 67		Fumagilin use (season)	Pr.S.	-0.200	[-0.28,-0.12]	-4.974	594	<0.001
Top 68		Average Queen Age	Pr.S.	-0.191	[-0.27,-0.11]	-4.740	594	<0.001
Top 69		Varroa Monitoring (Freq)	Pr.S.	-0.179	[-0.26,-0.1]	-4.423	594	<0.001
Top 70		Queens Replaced (Y/N)	Pr.S.	-0.166	[-0.24,-0.09]	-4.100	594	<0.001
Top 71		Feeding Products Type	Pr.S.	-0.150	[-0.23,-0.07]	-3.704	594	<0.001
Top 72		Feeding (Y/N)	Pr.S.	-0.131	[-0.21,-0.05]	-3.223	594	<0.005
Subset = Pr.M., N=334								
Top 1	*	Honey Produced (lbs)	Pr.M.	-0.172	[-0.28,-0.06]	-3.116	317	<0.005
Top 2	*	Varroa Monitoring Technique	Pr.M.	-0.294	[-0.39,-0.19]	-5.609	332	<0.001
Top 3	*	Winter Preparation Technique	Pr.M.	-0.351	[-0.44,-0.25]	-6.826	332	<0.001
Top 4	*	New Colonies Technique	Pr.M.	-0.336	[-0.43,-0.24]	-6.508	332	<0.001
Top 5	*	Amitraz use (season)	Pr.M.	-0.363	[-0.45,-0.27]	-7.094	332	<0.001
Top 6	*	Amitraz use (PCol)	Pr.M.	-0.371	[-0.46,-0.27]	-7.279	332	<0.001
Top 7	*	SBB (PCol)	Pr.M.	-0.378	[-0.47,-0.28]	-7.438	332	<0.001
Top 8	*	Varroa Products Applications (count)	Pr.M.	-0.367	[-0.46,-0.27]	-7.192	332	<0.001
Top 9	*	Action on Deadouts	Pr.M.	-0.365	[-0.45,-0.27]	-7.153	332	<0.001
Top 10	*	Nosema Products Applications (count)	Pr.M.	-0.373	[-0.46,-0.28]	-7.326	332	<0.001
Top 11	*	Oxalic Acid use (season)	Pr.M.	-0.386	[-0.47,-0.29]	-7.618	332	<0.001
Top 12	*	Queen Source	Pr.M.	-0.391	[-0.48,-0.3]	-7.735	332	<0.001
Top 13	*	Crops (count)	Pr.M.	-0.396	[-0.48,-0.3]	-7.867	332	<0.001
Top 14	*	States (count)	Pr.M.	-0.395	[-0.48,-0.3]	-7.825	332	<0.001
Top 15	*	Queens Replaced (PCol)	Pr.M.	-0.402	[-0.49,-0.31]	-7.998	332	<0.001
Top 16	*	Comb Culling and Storage Technique	Pr.M.	-0.404	[-0.49,-0.31]	-8.046	332	<0.001
Top 17	*	Nosema Monitoring (Freq)	Pr.M.	-0.410	[-0.5,-0.32]	-8.187	332	<0.001
Top 18	*	Thymol use (PCol)	Pr.M.	-0.411	[-0.5,-0.32]	-8.210	332	<0.001
Top 19	*	Terramycin use (PCol)	Pr.M.	-0.417	[-0.5,-0.32]	-8.352	332	<0.001
Top 20	*	Formic Acid use (PCol)	Pr.M.	-0.419	[-0.5,-0.33]	-8.416	332	<0.001
Top 21	*	Drone Removal (Freq)	Pr.M.	-0.421	[-0.51,-0.33]	-8.468	332	<0.001
Top 22	*	Powder Sugar use (months)	Pr.M.	-0.425	[-0.51,-0.33]	-8.548	332	<0.001
Top 23	*	Average Comb Age	Pr.M.	-0.428	[-0.51,-0.34]	-8.621	332	<0.001
Top 24	*	Drone Removal Amount	Pr.M.	-0.432	[-0.52,-0.34]	-8.729	332	<0.001
Top 25	*	Amitraz use (count)	Pr.M.	-0.433	[-0.52,-0.34]	-8.764	332	<0.001
Top 26		Varroa Products Type (count)	Pr.M.	-0.427	[-0.51,-0.33]	-8.593	332	<0.001
Top 27		Thymol use (count)	Pr.M.	-0.425	[-0.51,-0.33]	-8.563	332	<0.001
Top 28		SHB Trap use (month)	Pr.M.	-0.424	[-0.51,-0.33]	-8.538	332	<0.001
Top 29		Drone Removal (PCol)	Pr.M.	-0.423	[-0.51,-0.33]	-8.500	332	<0.001
Top 30		Average Queen Age	Pr.M.	-0.421	[-0.51,-0.33]	-8.455	332	<0.001
Top 31		Varroa Treatment (Y/N)	Pr.M.	-0.419	[-0.5,-0.33]	-8.417	332	<0.001

Top 32	Tylosin use (PCol)	Pr.M.	-0.417	[-0.5,-0.32]	-8.362	332	<0.001
Top 33	Honey Harvest (Y/N)	Pr.M.	-0.416	[-0.5,-0.32]	-8.337	332	<0.001
Top 34	Feeding (season)	Pr.M.	-0.413	[-0.5,-0.32]	-8.269	332	<0.001
Top 35	SHB Soil Drench use (month&PCol)	Pr.M.	-0.414	[-0.5,-0.32]	-8.276	332	<0.001
Top 36	Started New Cols (Y/N)	Pr.M.	-0.413	[-0.5,-0.32]	-8.259	332	<0.001
Top 37	Fluvalinate use (season)	Pr.M.	-0.412	[-0.5,-0.32]	-8.248	332	<0.001
Top 38	Coumaphos (SHB) use (PCol)	Pr.M.	-0.412	[-0.5,-0.32]	-8.248	332	<0.001
Top 39	Years of Beekeeping	Pr.M.	-0.403	[-0.49,-0.31]	-8.020	332	<0.001
Top 40	Nozevit use (PCol)	Pr.M.	-0.402	[-0.49,-0.31]	-8.006	332	<0.001
Top 41	Coumaphos (Varroa) use (season)	Pr.M.	-0.402	[-0.49,-0.31]	-7.997	332	<0.001
Top 42	Equipment Type	Pr.M.	-0.399	[-0.49,-0.31]	-7.936	332	<0.001
Top 43	Coumaphos (Varroa) use (PCol)	Pr.M.	-0.398	[-0.48,-0.3]	-7.912	332	<0.001
Top 44	Fluvalinate use (PCol)	Pr.M.	-0.397	[-0.48,-0.3]	-7.880	332	<0.001
Top 45	Oxalic Acid use (PCol)	Pr.M.	-0.394	[-0.48,-0.3]	-7.822	332	<0.001
Top 46	MiteAThol use (PCol)	Pr.M.	-0.393	[-0.48,-0.3]	-7.790	332	<0.001
Top 47	Nozevit use (season)	Pr.M.	-0.393	[-0.48,-0.3]	-7.784	332	<0.001
Top 48	MiteAThol use (season)	Pr.M.	-0.390	[-0.48,-0.3]	-7.722	332	<0.001
Top 49	Thymol use (season)	Pr.M.	-0.388	[-0.48,-0.29]	-7.674	332	<0.001
Top 50	Fumagilin use (PCol)	Pr.M.	-0.385	[-0.47,-0.29]	-7.602	332	<0.001
Top 51	Fumagilin use (season)	Pr.M.	-0.383	[-0.47,-0.29]	-7.554	332	<0.001
Top 52	ReQueening Technique	Pr.M.	-0.376	[-0.46,-0.28]	-7.399	332	<0.001
Top 53	Queens Replaced (Y/N)	Pr.M.	-0.367	[-0.46,-0.27]	-7.182	332	<0.001
Top 54	Moved across state lines (Y/N)	Pr.M.	-0.368	[-0.46,-0.27]	-7.200	332	<0.001
Top 55	SBB (months)	Pr.M.	-0.366	[-0.46,-0.27]	-7.173	332	<0.001
Top 56	SHB Bait Type	Pr.M.	-0.363	[-0.45,-0.27]	-7.098	332	<0.001
Top 57	Foundation Type	Pr.M.	-0.358	[-0.45,-0.26]	-6.990	332	<0.001
Top 58	Varroa IPM Practices (count)	Pr.M.	-0.356	[-0.45,-0.26]	-6.940	332	<0.001
Top 59	SHB Control Technique	Pr.M.	-0.348	[-0.44,-0.25]	-6.759	332	<0.001
Top 60	Sources of Information (count)	Pr.M.	-0.342	[-0.43,-0.24]	-6.624	332	<0.001
Top 61	Feeding (Y/N)	Pr.M.	-0.339	[-0.43,-0.24]	-6.573	332	<0.001
Top 62	Terramycin use (season)	Pr.M.	-0.333	[-0.43,-0.23]	-6.440	332	<0.001
Top 63	Hop Oil use (PCol)	Pr.M.	-0.326	[-0.42,-0.23]	-6.288	332	<0.001
Top 64	Nosema Monitoring Technique	Pr.M.	-0.317	[-0.41,-0.22]	-6.088	332	<0.001
Top 65	Tylosin use (season)	Pr.M.	-0.310	[-0.4,-0.21]	-5.932	332	<0.001
Top 66	October Brood Chamber Size	Pr.M.	-0.304	[-0.4,-0.2]	-5.820	332	<0.001
Top 67	Varroa Monitoring (Freq)	Pr.M.	-0.297	[-0.39,-0.2]	-5.662	332	<0.001
Top 68	Beekeeping Education	Pr.M.	-0.290	[-0.38,-0.19]	-5.514	332	<0.001
Top 69	Formic Acid use (season)	Pr.M.	-0.283	[-0.38,-0.18]	-5.369	332	<0.001
Top 70	Brood Inspection (Freq)	Pr.M.	-0.275	[-0.37,-0.17]	-5.221	332	<0.001
Top 71	Nosema Treatment (Y/N)	Pr.M.	-0.268	[-0.36,-0.17]	-5.065	332	<0.001
Top 72	Feeding Products Type	Pr.M.	-0.255	[-0.35,-0.15]	-4.806	332	<0.001

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